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ABSTRACT

This document contains six learning activity packets (LAPs) that outline the study activities for the "suspension" instructional area for an Auto Mechanics I course. The six LAPs cover the following topics: wheel bearings, tires and wheels, wheel balancing, suspension system, steering system, and wheel alignment. Each LAP contains a cover sheet that describes its purpose, an introduction, and the tasks included in the LAP; learning steps (checklist); pretest; and various assignment sheets. Materials are illustrated with line drawings. The LAPs are referenced to a curriculum guide for the Auto Mechanics I course. (KC)

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ED279810

Learning Activity Packets (LAPs)

Auto Mechanics I

Section D — Suspension

- LAP #16 — Wheel Bearings
- LAP #17 — Tires and Wheels
- LAP #18 — Wheel Balancing
- LAP #19 — Suspension System
- LAP #20 — Steering System
- LAP #21 — Wheel Alignment

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**State Department
of
Vocational and Technical
Education
CIMC
Stillwater, Oklahoma
LEARNING ACTIVITY
PACKETS**

for AUTO MECHANICS I

MAJOR INSTRUCTIONAL AREA

SUSPENSION

INSTRUCTIONAL UNIT

WHEEL BEARINGS
SECTION D--UNIT I

LEARNING ACTIVITY PACKET NO.

16

PREREQUISITE LAP(S)

1, 2

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Wheel Bearings." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to identify types of front wheel bearing assemblies and to perform necessary maintenance on the assembly.

TASKS INCLUDED IN THIS LAP:

1. Clean and inspect a bearing.
2. Adjust front wheel bearings.
3. Pack a front wheel bearing assembly.

AUTO MECHANICS I
WHEEL BEARINGS
SECTION D--UNIT I

Check the Following
Blanks as You Complete
Each Required Steps

- ____ 1. Read Unit and Specific Objectives, page 1-D.
- ____ 2. Complete Wheel Bearings Pre-Test, LAP page 5.
- ____ 3. Study The Sections of the Information Sheet, pages 5-D through 7-D, indicated by your instructor on your Pre-Test. Be sure to study the transparency masters when required.
- ____ 4. Do LAP Assignment Sheet #1, LAP page 9.
- ____ 5. Do LAP Assignment Sheet #2, LAP page 13.
- ____ 6. Check The tasks below which you feel that you can do without supervision.

Student
Check

Instructor
Initials/Date

- | | Skilled | Moderately
Skilled |
|---|---------|-----------------------|
| ____ a. Clean and inspect a bearing (9). | _____ | _____ |
| ____ b. Adjust front wheel bearings (15). | _____ | _____ |
| ____ c. Pack a front wheel bearing assembly (21). | _____ | _____ |
-
- ____ 7. Discuss Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If all tasks have been initialed, proceed to Step 27. Otherwise, continue to Step 8.

- ___ 8. Refer To Step 6a. If this task has been initialed, proceed to Step 14. Otherwise, continue to Step 9.
- ___ 9. Study Job Sheet #1--Clean and Inspect a Bearing, page 15-D.
- ___ 10. Watch Slide/tape presentation "Clean and Inspect a Bearing" (D-I-1).
- ___ 11. Do Job Sheet #1--Clean and Inspect a Bearing.
- ___ 12. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and continue to Step 14. Otherwise, repeat Steps 9-11 and then go to Step 13.
- ___ 13. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and continue to Step 14. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6a and continue to Step 14.
- ___ 14. Refer To Step 6b. If this task has been initialed, proceed to Step 20. Otherwise, continue to Step 15.
- ___ 15. Study Job Sheet #2--Adjust Front Wheel Bearings, page 17-D.
- ___ 16. Watch Slide/tape presentation "Adjust Front Wheel Bearings (D-I-2).
- ___ 17. Do Job Sheet #2--Adjust Front Wheel Bearings
- ___ 18. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and proceed to Step 20. Otherwise, repeat Steps 15-17 and then go to Step 19.

- ____ 19. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and continue to Step 20. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6b and continue to Step 20.
- ____ 20. Refer To Step 6c. If this task has been initialed, proceed to Step 26. Otherwise, continue to Step 21.
- ____ 21. Study Job Sheet #3--Pack a Front Wheel Bearing Assembly, page 21-D.
- ____ 22. Watch Slide/tape presentation "Pack a Front Wheel Bearing Assembly" (D-I-3).
- ____ 23. Do Job Sheet #3--Pack a Front Wheel Bearing Assembly.
- ____ 24. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6c and proceed to Step 26. Otherwise, repeat Steps 21-23 and then go to Step 25.
- ____ 25. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6c and continue to Step 26. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6c and continue to Step 26.
- ____ 26. Refer To Step 6. If all tasks have been initialed, continue to Step 27. Otherwise, refer to the step number in parentheses after the unsigned task.
- ____ 27. Study Information Sheet (page 5-D).

____ 28. Take

Wheel Bearings Unit I Test (see your instructor). If you achieve a score of 85 percent or more, continue to the next assigned Learning Activity Packet. Otherwise, discuss additional training and possible re-testing requirements with your instructor.

WHEEL BEARINGS
UNIT I

PRE-TEST

NAME _____

SCORE _____

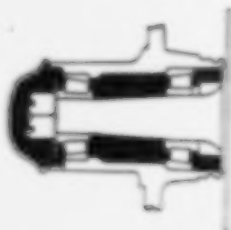
DIRECTIONS: This test is to determine how much you already know about wheel bearings. Your performance on this test will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. Answer only those questions for which you are certain of the answer. Guessing may prevent you from receiving the lessons which are required.

1. Match the terms on the right to the correct definitions. Definitions continue on next page.

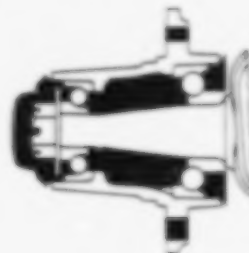
- | | | | |
|----------|---|-----|----------------------|
| _____ a. | Process of cleaning the old grease from bearings and then forcing new wheel bearing grease into the openings between the races and the ball or roller cages | 1. | Antifriction bearing |
| _____ b. | Part of the bearing which contains the outer race; installed in the hub with a press fit | 2. | Press fit |
| _____ c. | Bearing which does not require periodic lubrication | 3. | Push fit |
| _____ d. | Adjustment of antifriction bearings so that they will work under mild pressure | 4. | Bearing creep |
| _____ e. | Installation of a bearing cup with a tight or interference fit requiring more than hand force to install | 5. | Preload |
| _____ f. | Bearing containing rollers or balls plus an inner and outer race that allows the load to roll on the balls or rollers thus minimizing friction | 6. | End play |
| _____ g. | Part of bearing which regulates end play | 7. | Packing bearings |
| _____ h. | Installation of a bearing cone with a light fit that can be installed with hand pressure | 8. | Bearing race |
| _____ i. | Tendency of bearing adjusting nut to loosen | 9. | Bearing cone |
| | | 10. | Brinelling |
| | | 11. | Bearing cup |

- ____ j. Very slow, steady rotation of a push fit bearing race to keep changing the area of greatest load and thus increase bearing life
- ____ k. Surface of the groove or path on which the balls or rollers of a bearing roll
- ____ l. Amount of axial movement in the hub due to clearance in the bearings
- ____ m. Process of applying brinell grease to bearings
- ____ n. Part of the roller bearing which contains the inner race, roller cage, and rollers; installed on the spindle with a push fit
- ____ o. Notch in the race caused by improper installation of bearings

2. Identify the two types of front wheel bearings in the illustrations below.

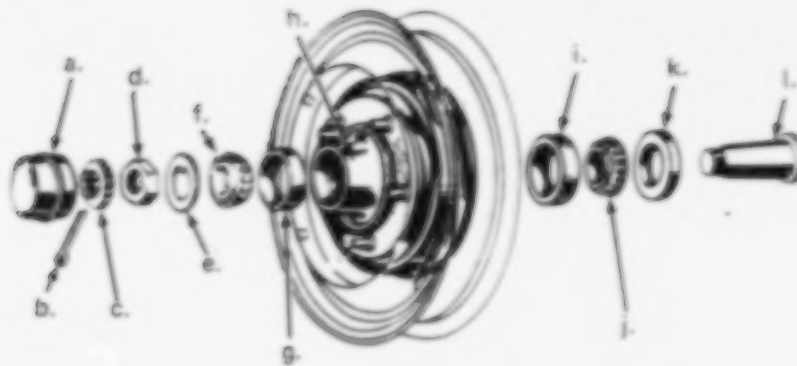


a. _____



b. _____

3. Identify the parts of the front wheel bearing assembly in the illustration below.



a. _____
 b. _____
 c. _____
 d. _____
 e. _____
 f. _____

g. _____
 h. _____
 i. _____
 j. _____
 k. _____
 l. _____

4. List four characteristics of quality wheel bearing grease.

a. _____
 b. _____
 c. _____
 d. _____

5. State precautions to observe while packing wheel bearings by explaining what precautions apply to the following words or phrases

a. Mixing grease -- _____

 b. Cleanliness -- _____

 c. Handling bearings -- _____

 d. Removing hub -- _____

- e. Drying with compressed air -- _____

- f. Grease seals -- _____

- g. Cotter pins -- _____

- h. Defective bearings -- _____

6. Stop. Have your instructor evaluate your Pre-Test and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

_____ I	_____ IV
_____ II	_____ V
_____ III	

You came here from LAP Step 2. If any of the above areas is checked, continue to LAP Step 3. Otherwise, proceed to LAP Step 6.

WHEEL BEARINGS
UNIT I

LAP ASSIGNMENT SHEET #1--WHEEL BEARINGS

NAME _____

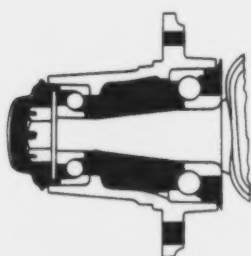
SCORE _____

1. Match the terms on the right to their correct definitions. Definitions continue on next page.

- | | |
|---|--|
| <p>_____ a. Process of cleaning the old grease from bearings and then forcing new wheel bearing grease into the openings between the races and the ball or roller cages</p> <p>_____ b. Part of the bearing which contains the outer race; installed in the hub with a press fit</p> <p>_____ c. Adjustment of antifriction bearings so that they will work under mild pressure</p> <p>_____ d. Installation of a bearing cup with a tight or interference fit requiring more than hand force to install</p> <p>_____ e. Bearing containing rollers or balls plus an inner and outer race that allows the load to roll on the balls or rollers thus minimizing friction</p> <p>_____ f. Installation of a bearing cone with a light fit that can be installed with hand pressure</p> <p>_____ g. Very slow, steady rotation of a push fit bearing race to keep changing the area of greatest load and thus increase bearing life</p> <p>_____ h. Surface of the groove or path on which the balls or rollers of a bearing roll</p> <p>_____ i. Amount of axial movement in the hub due to clearance in the bearings</p> | <p>1. Bearing cone</p> <p>2. Push fit</p> <p>3. Brinelling</p> <p>4. Antifriction bearing</p> <p>5. Bearing cup</p> <p>6. Press fit</p> <p>7. Bearing race</p> <p>8. Bearing creep</p> <p>9. Packing bearings</p> <p>10. Preload</p> <p>11. End play</p> |
|---|--|

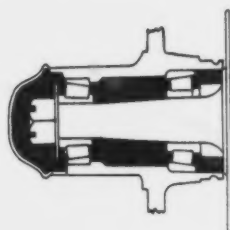
- ____ j. Part of the roller bearing
which contains the inner
race, roller cage, and rollers;
installed on the spindle with
a push fit
- ____ k. Notch in the race caused by
improper installation of
bearings

2. Identify the types of front wheel bearings illustrated below by unscrambling the names and writing them in the blanks provided.



L A L B

G E B R A I N



P R E D A T E

L O R R E L

N A G I B E R

3. Identify the parts of the tapered roller front wheel bearing assembly in the diagram below by drawing a line from the part to its correct name.

Adjusting nut

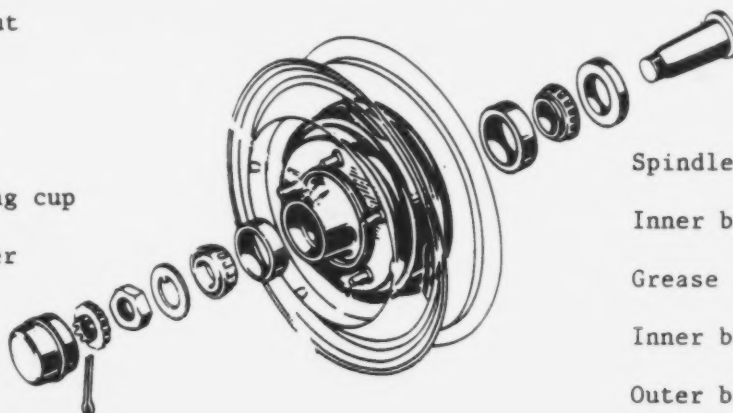
Grease cup

Hub

Outer bearing cup

Thrust washer

Cotter pin



Spindle

Inner bearing cup

Grease seal

Inner bearing cone

Outer bearing cone

Nut lock

4. List four characteristics of quality wheel bearing grease by placing an "X" beside each correct characteristic below.

- ___ a. Good tensile strength
- ___ b. Water resistant
- ___ c. High temperature stability
- ___ d. Least expensive brand available
- ___ e. Good mechanical and chemical stability
- ___ f. Clear in color
- ___ g. Water soluble

5. State five precautions to observe while packing wheel bearings. Each of the following statements has one or more incorrect words in it. Cross out the incorrect word and write the correct response in the blank provided.

- a. Do not mix gold and blue grease or greases of different space material.

- b. Keep bearings and grease around

- c. Handle bearings with care to avoid bending the cone or chipping the rollers or races

d. Do not drag the tub over the sprinkler

e. Do not spin the earrings when drying with depressed air

f. Replace wormy or defective Grecian seals

g. Use two blotter pins

h. Inspect for detective hearing

6. Stop. Have your instructor evaluate your Assignment Sheet and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

____ I
____ II
____ III

____ IV
____ V

If none of the above areas is checked, proceed to LAP Step 6. Otherwise, study the required areas and then continue to LAP Step 5.

WHEEL BEARINGS
UNIT I

LAP ASSIGNMENT SHEET #2--WHEEL BEARINGS

NAME _____ SCORE _____

1. Define the following terms.

- a. Bearing cone -- _____

- b. Bearing creep -- _____

- c. Bearing cup -- _____

- d. Bearing race -- _____

- e. Antifriction bearing -- _____

- f. Brinelling -- _____

- g. End play -- _____

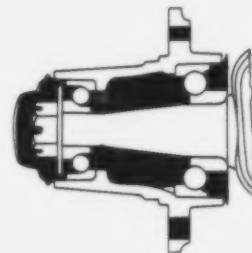
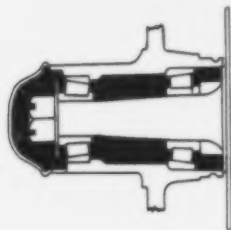
- h. Packing bearings -- _____

- i. Preload -- _____

- j. Press fit -- _____

- k. Push fit -- _____

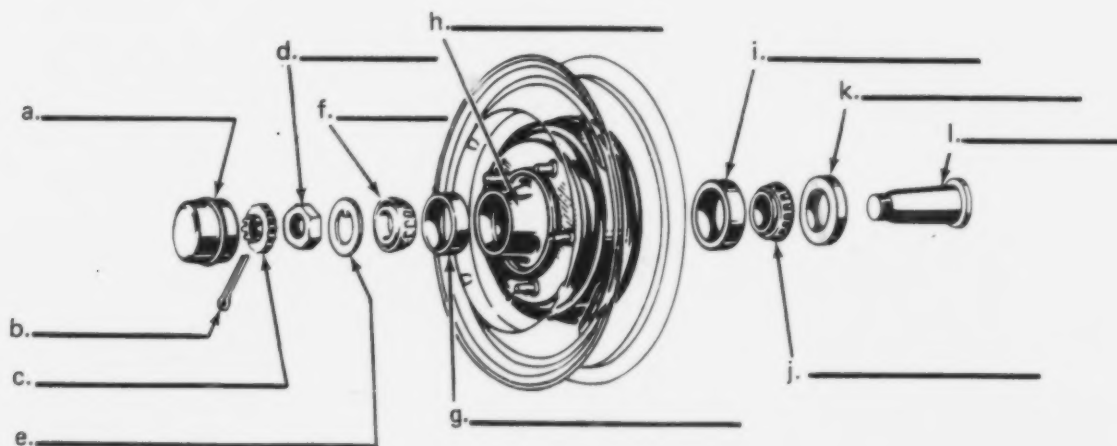
2. Identify the types of front wheel bearings illustrated below.



a. _____

b. _____

3. Identify the parts of the tapered roller front wheel bearing assembly in the diagram below.



4. List four characteristics of quality wheel bearing grease.

- a.
- b.
- c.
- d.

5. State precautions to observe while packing wheel bearings.
 - a.
 - b.
 - c.
 - d.
 - e.
 - f.
 - g.
 - h.
6. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance continue to LAP Step 6. Otherwise, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 6.

**State Department
of
Vocational and Technical
Education
CIMC
Stillwater, Oklahoma
LEARNING ACTIVITY
PACKETS
for AUTO MECHANICS I**

MAJOR INSTRUCTIONAL AREA

SUSPENSION

INSTRUCTIONAL UNIT

TIRES AND WHEELS
SECTION D--UNIT II

LEARNING ACTIVITY PACKET NO.

17

PREREQUISITE LAP(S)

1, 2

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Tires and Wheels." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to state the basic functions of tires; identify the types of tire construction, abnormal tire wear patterns, and tire size markings; and demonstrate the ability to perform tire maintenance.

TASKS INCLUDED IN THIS LAP:

1. Remove, inspect, and replace a tire on a wheel.
2. Repair a tire puncture.

AUTO MECHANICS I
TIRES AND WHEELS
SECTION D--UNIT II

LEARNING STEPS

Check the Following
Blanks as You Complete
Each Required Step

- ____ 1. Read Unit and Specific Objectives, page 35-D.
- ____ 2. Complete Tires and Wheels Pre-Test, LAP page 5.
- ____ 3. Study The Sections of the Information Sheet, pages 39-D through 44-D, indicated by your instructor on your Pre-Test. Be sure to study the transparency masters when required.
- ____ 4. Refer To Step 17 of your Pre-Test. If any of Sections IA-VII are indicated for additional study, continue to Step 5. Otherwise, proceed to Step 7.
- ____ 5. Do LAP Assignment Sheet #1, LAP page 15.
- ____ 6. Do LAP Assignment Sheet #2, LAP page 19.
- ____ 7. Refer To Step 17 of your Pre-Test. If Section I-B or any of Sections VIII-XV are indicated for additional study, continue to Step 8. Otherwise, proceed to Step 10.
- ____ 8. Do LAP Assignment Sheet #3, LAP page 23.
- ____ 9. Do LAP Assignment Sheet #4, LAP page 29.

- ____ 10. Check The tasks below which you feel that you can do without supervision.

Student
Check

Instructor
Initials/Date

		Skilled	Moderately Skilled
____ a.	Remove, inspect, and replace a tire on a wheel (12).	_____	_____
____ b.	Repair a tire puncture (18).	_____	_____

- ____ 11. Discuss Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If both tasks have been initialed, proceed to Step 24. Otherwise, continue to Step 12.

- ____ 12. Study Job Sheet #1--Remove, Inspect, and Replace a Tire on a Wheel, page 71-D.

- ____ 13. Watch Slide/tape presentation "Remove, Inspect, and Replace a Tire on a Wheel" (D-II-1).

- ____ 14. Do Job Sheet #1--Remove, Inspect, and Replace a Tire on a Wheel.

- ____ 15. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 10a and proceed to Step 17. Otherwise, repeat Steps 12-14 and then go to Step 16.

- ____ 16. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 10a and continue to Step 17. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 10a and continue to Step 17.

- ____ 17. Refer To Step 10b. If this task has been initialed, proceed to Step 23. Otherwise, continue to Step 18.
- ____ 18. Study Job Sheet #2--Repair a Tire Puncture, page 77-D.
- ____ 19. Watch Slide/tape presentation "Repair a Tire Puncture" (D-II-2).
- ____ 20. Do Job Sheet #2--Repair a Tire Puncture.
- ____ 21. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 10b and proceed to Step 23. Otherwise, repeat Steps 18-20 and then go to Step 22.
- ____ 22. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 10b and continue to Step 23. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 10b and continue to Step 23.
- ____ 23. Refer To Step 10. If both tasks have been initialed, continue to Step 24. Otherwise, go to the step indicated in parentheses after the unsigned task.
- ____ 24. Review Information Sheet, page 39-D.
- ____ 25. Take Tires and Wheels Unit II Test (see your instructor). If you achieve an 85 percent or more, continue to the next assigned Learning Activity Packet. Otherwise, discuss additional training requirements and possible re-testing with your instructor.

TIRES AND WHEELS
UNIT II
PRE-TEST

NAME _____ SCORE _____

DIRECTIONS: This test is to determine how much you already know about tires and wheels. Your performance on this test will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. Answer only those questions for which you are certain of the answer. Guessing may prevent you from receiving the lessons which are required.

Part A

1. Match the terms on the right to their correct definitions. Definitions continue on next page.

- | | |
|---|---|
| <p>_____ a. Body ply that is laid at a 90° angle from bead to bead</p> <p>_____ b. Body ply that is laid on a bias (30°-60° angle) from bead to bead with the cord angle reversed on alternating plies</p> <p>_____ c. The portion of the tire that bears against the rim flange and consists of a number of turns of steel wire to provide greater strength</p> <p>_____ d. Ply applied directly beneath the tire tread and parallel to the tread</p> <p>_____ e. Exposed area of ply belts on outside wall of tire</p> <p>_____ f. Area of the tire that contacts the road</p> <p>_____ g. Main body of the tire exclusive of the tread</p> <p>_____ h. Device attached to valve stem which changes color as tire wears</p> <p>_____ i. One-half inch (12.7 mm) wide bands across the tread that appear when tread depth is reduced to 1/16 inch (1.587 mm)</p> | <p>1. Tire tread</p> <p>2. Tire bead</p> <p>3. Tire casing</p> <p>4. Tire ply</p> <p>5. Bias ply</p> <p>6. Radial ply</p> <p>7. Vulcanizing</p> <p>8. Stabilizer belt</p> <p>9. Tire separation</p> <p>10. Tire tread wear</p> <p>11. Tire and wheel runout</p> |
|---|---|

- ____j. How true the tire or wheel rotates with respect to lateral movement and radial movement
- ____k. Layer of cord impregnated with rubber and shaped to form the body of the tire
- ____l. Process for removing the tire bead from the rim
- ____m. Bulge on a tire where air has penetrated through the body plies and separated the sidewall of tread from the outer ply
- ____n. Process of heating rubber under pressure to give shape and desired characteristics to the tire

Part B (Definitions continue on next page.)

- | | |
|--|----------------------|
| ____a. Distance around rim at bead seat | 1. Drop center wheel |
| ____b. Ratio of tire height to tire width | 2. Tire load range |
| ____c. Check valve installed in the valve stem that allows air to enter the tire or tube but prevents air from escaping | 3. Aspect ratio |
| ____d. Tire that seals to the rim with grooves on the tire bead area and seals the casing with a soft rubber inner surface, eliminating the need for an inner tube | 4. Valve core |
| ____e. System that replaces the ply system for indicating weight-carrying capacity of a tire | 5. Inner tube |
| ____f. Air-tight rubber tube placed inside the casing of a pneumatic tire to hold air under pressure | 6. Tubeless tire |
| ____g. Life expectancy of tire based on lower wear for greater circumference | 7. Rim diameter |
| | 8. Tire size range |
| | 9. Valve stem |

- ____ h. Rim that has a broad groove or "dropped" area in its center to allow the removal of the tire
- ____ i. Wheel with slightly offset hub opening for increased stability
- ____ j. Prefix letter of the tire size sidewall; refers to the vehicle body size (compact, intermediate, and full-size) that the tire is designed to fit
- ____ k. Rubber tube mounted in the rim or attached to the inner tube to provide a way to inflate the tire
- ____ l. Diameter of the wheel from tire bead seat to tire bead seat

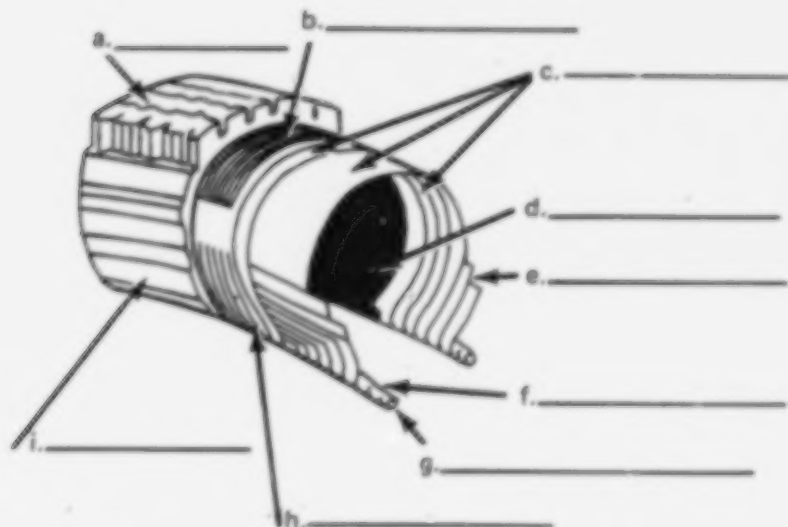
2. State the functions of tires.

3. Name two basic types of tires.

a.

b.

4. Identify the parts of the tire in the illustration below.



5. Describe each of the following plies in a tire.

- a. Radial ply -- _____

- b. Bias ply -- _____

- c. Belted ply -- _____

6. Give advantages of various tire cords.

- a. Rank the following cords in order of tensile strength by placing a one beside the cord with the greatest tensile strength and numbering to the lowest.

- ____ (1) Polyester
 ____ (2) Fiberglass
 ____ (3) Nylon
 ____ (4) Rayon

b. List at least two advantages of the following types of cords.

(1) Polyester

(a)

(b)

(2) Fiberglass

(a)

(b)

(3) Nylon

(a)

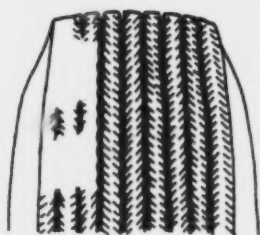
(b)

(4) Rayon

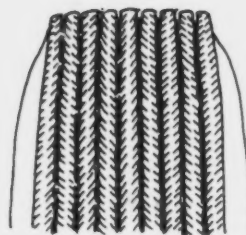
(a)

(b)

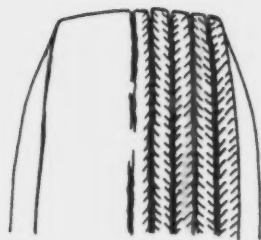
7. Identify the problems which leads to each of the following abnormal wear patterns



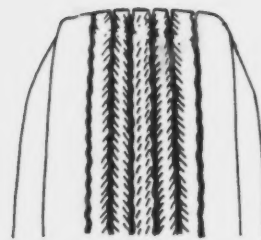
a. _____



b. _____



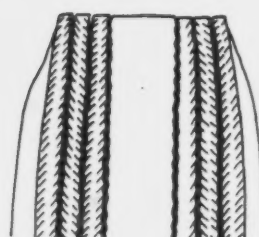
c. _____



d. _____

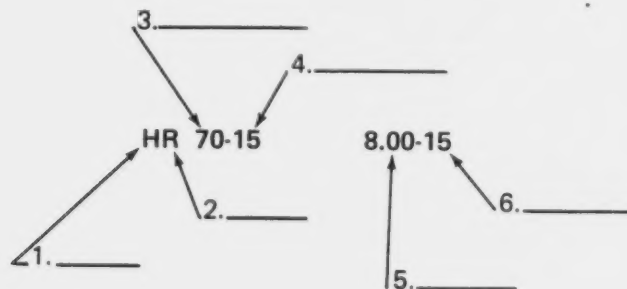


e. _____



f. _____

8. Identify the meaning of the components of the tire size markings given by placing the letter of the correct meaning in the blanks under each size marking.



- a. Early marking for rim diameter in inches
- b. Size range
- c. Aspect ratio
- d. Radial ply
- e. Tire height in inches
- f. Later marking for rim diameter in inches

9. Complete the following chart by filling in the correct load range rating.

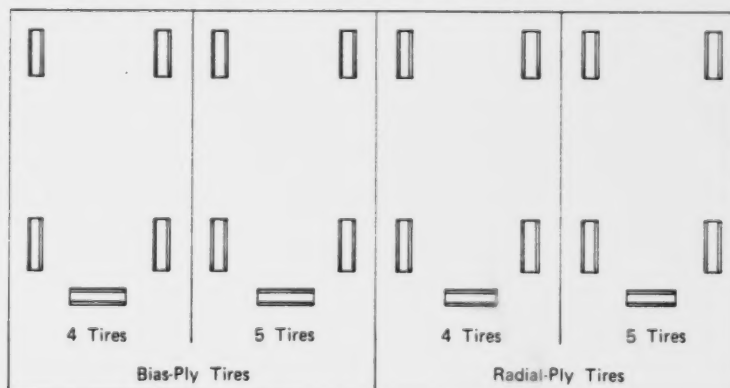
Load Range	Tire Ply Rating
B	2 ply with 4 ply rating; 4 ply
C	6 ply
D	4 ply with 8 ply rating; 8 ply

10. Discuss tire inflation pressure.

11. List three reasons for periodic tire rotation.

- a.
- b.
- c.

12. Draw tire rotation patterns for the following types of tires by placing arrows in the direction of tire movement.



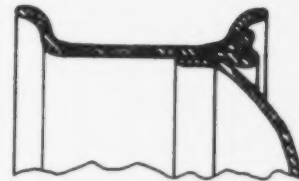
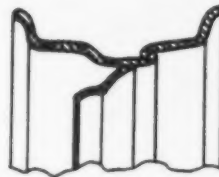
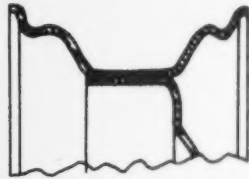
13. List three methods of repairing minor tire punctures.

a.

b.

c.

14. Identify the following types of wheels

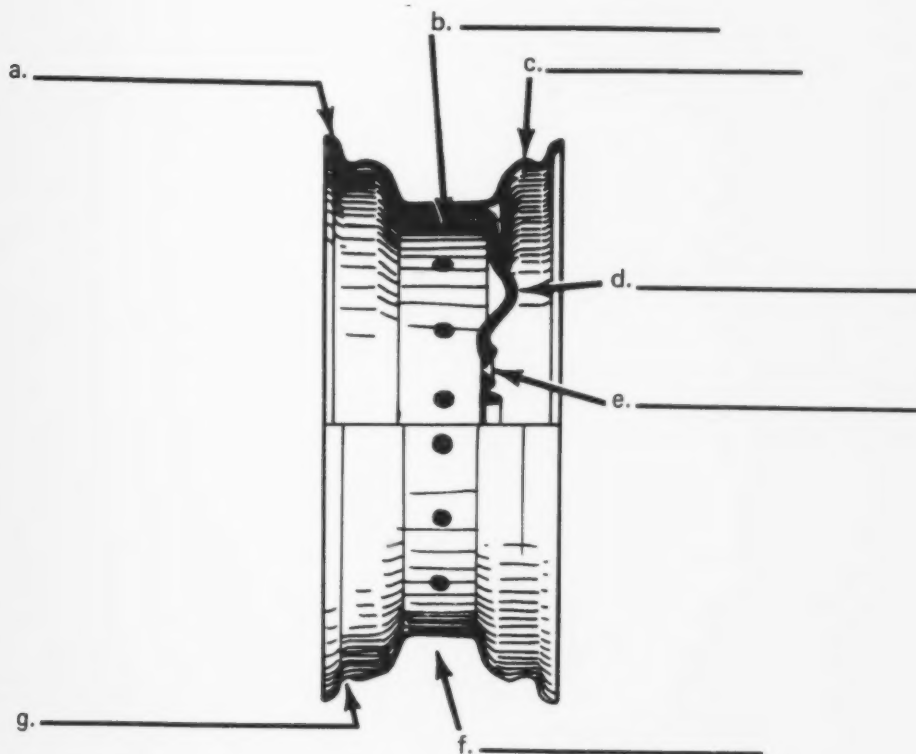


a. _____

b. _____

c. _____

15. Identify the parts of the wheel in the drawing below.



16. Stop. Have your instructor evaluate your Pre-Test and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

____ I - Part A (a-k)	____ VIII
____ I - Part B (l-t)	____ IX
____ II	____ X
____ III	____ XI
____ IV	____ XII
____ V	____ XIII
____ VI	____ XIV
____ VII	____ XV

You came here from LAP Step 2. If any of the above study areas is checked, go to LAP Step 3. Otherwise, proceed to LAP Step 10.

TIRES AND WHEELS
UNIT II

LAP ASSIGNMENT SHEET #1--TIRE DESIGN

NAME _____ SCORE _____

1. Match the terms on the right to their correct definitions. Write the number of the term in the blank provided. Definitions continue on next page.

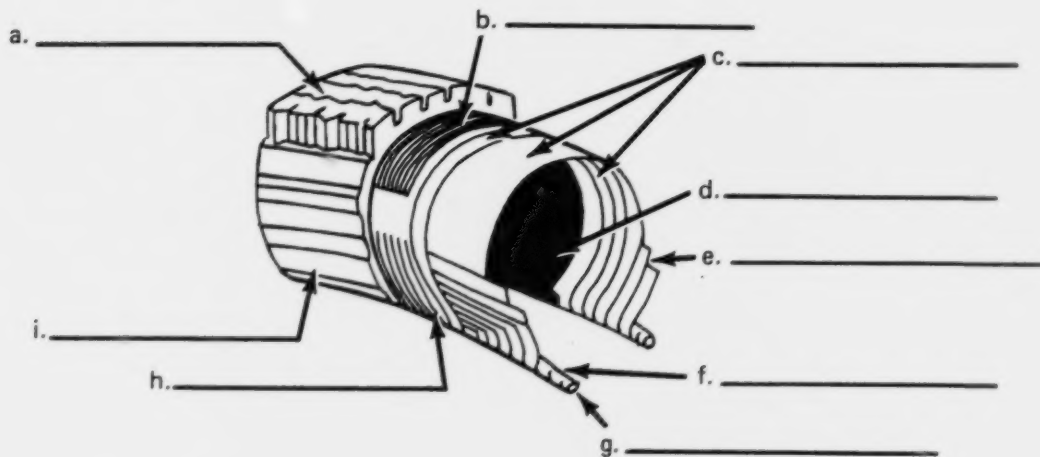
- | | |
|---|---|
| <p>_____ a. Body ply that is laid at a 90° angle from bead to bead</p> <p>_____ b. Body ply that is laid on a bias (30°-60° angle) from bead to bead with the cord angle reversed on alternating plies</p> <p>_____ c. That portion of the tire that bears against the rim flange and consists of a number of turns of steel wire to provide greater strength</p> <p>_____ d. Area of the tire that contacts the road</p> <p>_____ e. Main body of the tire exclusive of the tread</p> <p>_____ f. One-half inch (12.7 mm) wide bands across the tread that appear when tread depth is reduced to 1/16 inch (1.587 mm)</p> <p>_____ g. How true the tire or wheel rotates with respect to lateral movement and radial movement</p> <p>_____ h. Layer of cord impregnated with rubber and shaped to form the body of the tire</p> <p>_____ i. Ply applied directly beneath the tire tread and parallel to the tread</p> <p>_____ j. Bulge on a tire where air has penetrated through the body plies and separated the sidewall or tread from the outer ply</p> | <p>1. Tire and wheel runout</p> <p>2. Tire tread</p> <p>3. Tire tread wire indicator</p> <p>4. Tire bead</p> <p>5. Tire separation</p> <p>6. Tire casing</p> <p>7. Tire ply</p> <p>8. Vulcanizing</p> <p>9. Bias ply</p> <p>10. Stabilizer belt</p> <p>11. Radial ply</p> |
|---|---|

- _____ k. Process of heating rubber under pressure to give shape and desired characteristics to the tire
2. Identify the basic functions of a tire by placing an "X" beside each correct function.
- _____ a. Give effective braking action
- _____ b. Absorb the shock of irregular road surfaces
- _____ c. Provide good traction between the road and the wheel
- _____ d. Keep the vehicle from swaying on turns
3. Unscramble the two terms below to name the basic types of tires.
- S L U E B E E T S U B E T
- a. _____ b. _____
4. Identify the parts of the tire in the drawing below. Write the correct term in the blank provided.

Undertread
Bead wrapping
Inner liner

Bead wires
Rubber chafer
Wall rubber

Casing plies
Tread
Fillers



5. Match methods of laying plies to their correct descriptions.

- | | | |
|----------|--|---------------|
| _____ a. | The casing plies are laid crisscross at an angle at 30° to 38° | 1. Radial ply |
| _____ b. | Additional plies are added directly under the tire tread | 2. Bias ply |
| _____ c. | The casing plies are laid at right angles to the circumference of the tire | 3. Belted ply |

6. Complete the chart below by filling in the correct cord material from the following list.

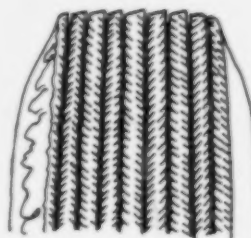
Rayon	Nylon	Polyester	Fiberglass
Cord Type	Tensile Strength, PSI		Advantages
a.	122,000 psi (8577.57 kg/cm ²)		High heat resistance, excellent impact resistance, minimum flex, water repellent
b.	94,000 psi (6608.95 kg/cm ²)		Soft ride, resilient, inexpensive
c.	407,000 psi (28,615.35 kg/cm ²)		Greatest strength, soft ride
d.	104,000 psi (7322.03 kg/cm ²)		Soft ride, more heat resistant, inexpensive

7. Identify the abnormal tire tread wear patterns below by unscrambling the term given.



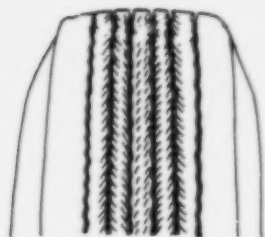
I N O T E

a. _____ wear



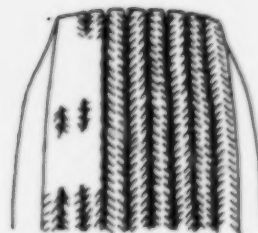
R I C E G R O N N

b. _____ wear



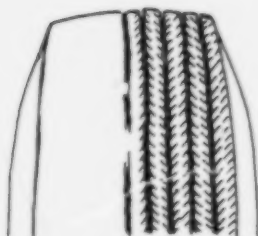
ENFRIONILUDANT

c. _____ wear



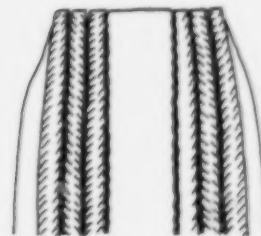
BUMMERTOLLIP

d. _____ wear



BRACEM

e. _____ wear



ONIONLIVERAFT

f. _____ wear

8. Stop. Have your instructor evaluate your Assignment Sheet and mark the areas below which require additional study. Refer to Information Sheets, Sections:

____ I Part A (a-k)

____ V

____ II

____ VI

____ III

____ VIII

____ IV

If any of the above areas is checked, study the required sections and then go to LAP Step 6. Otherwise, proceed to LAP Step 7.

TIRES AND WHEELS
UNIT II

LAP ASSIGNMENT SHEET #2--TIRE DESIGN

NAME _____ SCORE _____

1. Define the following terms.

- a. Bias ply -- _____

- b. Radial ply -- _____

- c. Stabilizer belt -- _____

- d. Tire bead -- _____

- e. Tire casing -- _____

- f. Tire ply -- _____

- g. Tire separation -- _____

h. Tire tread -- _____

i. Tire tread wear indicator -- _____

j. Vulcanizing -- _____

k. Tire and wheel runout -- _____

2. Name the two basic functions of a tire.

a. _____

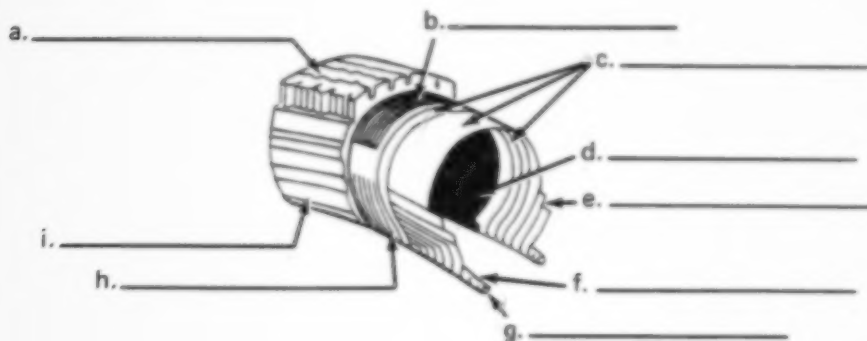
b. _____

3. Name the two basic types of tires.

a. _____

b. _____

4. Identify the parts of the tire in the drawing below.



5. Describe the following methods of laying plies.

- a. Bias ply -- _____

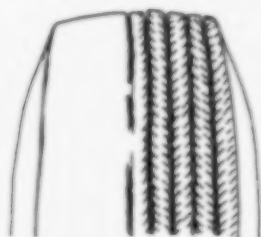
- b. Radial ply -- _____

- c. Belted ply -- _____

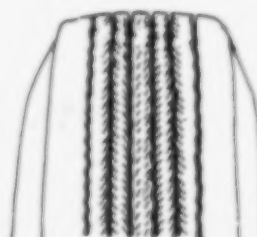
6. Match the cord types on the right to their correct descriptions.

- | | |
|---|---------------|
| _____ a. Tensile strength of 122,000 psi | 1. Rayon |
| _____ b. Greatest strength, soft ride | 2. Polyester |
| _____ c. High heat resistance, excellent impact resistance, maximum flex, water repellent | 3. Nylon |
| _____ d. Tensile strength of 104,000 psi | 4. Fiberglass |
| _____ e. Tensile strength of 407,000 psi | |
| _____ f. Soft ride, resilient, inexpensive | |
| _____ g. Tensile strength of 94,000 psi | |
| _____ h. Soft ride, more heat resistant, inexpensive | |

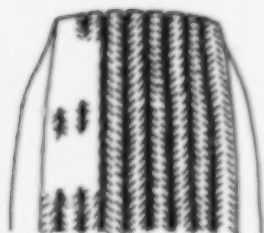
7. Identify the abnormal tread wear patterns illustrated below.



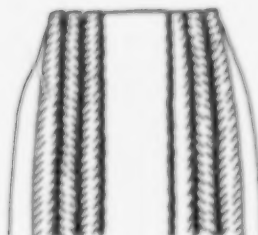
a. _____



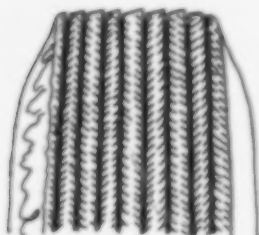
b. _____



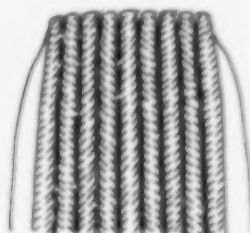
c. _____



d. _____



e. _____



f. _____

8. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, continue to LAP Step 7. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 7.

TIRES AND WHEELS
UNIT II

LAP ASSIGNMENT SHEET #3--TIRE RATINGS AND WHEEL DESIGN

NAME _____ SCORE _____

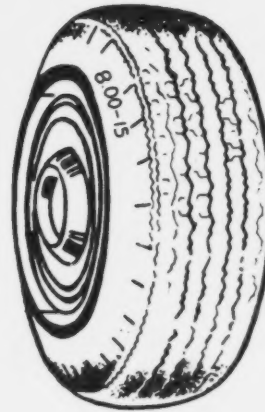
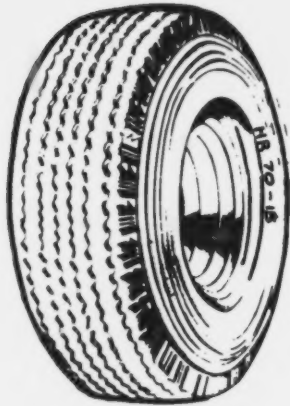
1. Match the terms on the right to their correct definitions. Write the number of the correct term in the space provided.

- | | |
|---|-----------------------------|
| <p>_____ a. Rubber tube mounted in the rim or attached to the inner tube to provide a way to inflate the tire</p> | <p>1. Drop center wheel</p> |
| <p>_____ b. Diameter of the wheel from tire bead seat to tire bead seat</p> | <p>2. Tire size range</p> |
| <p>_____ c. Rim that has a broad groove or "dropped" area in its center to allow the removal of the tire</p> | <p>3. Tire load range</p> |
| <p>_____ d. Ratio of tire height to tire width</p> | <p>4. Aspect ratio</p> |
| <p>_____ e. Check valve installed in the valve stem that allows air to enter the tire or tube but prevents air from escaping</p> | <p>5. Rim diameter</p> |
| <p>_____ f. Tire that seals to the rim with sealing grooves on the tire bead area and seals the casing with a soft rubber inner surface, eliminating the need for an inner tube</p> | <p>6. Valve stem</p> |
| <p>_____ g. System that replaces the ply system for indicating weight-carrying capacity of a tire</p> | <p>7. Valve core</p> |
| <p>_____ h. Air-tight rubber tube placed inside the casing of a pneumatic tire to hold air under pressure</p> | <p>8. Inner tube</p> |
| <p>_____ i. Prefix letter of the tire size markings located on the tire sidewall; refers to the vehicle body size (compact, intermediate, and full-size) that the tire is designed to fit</p> | <p>9. Tubeless tire</p> |

2. Identify the following tire size markings as either early-type or late-type markings by writing the correct term in the blank provided.

a. _____

b. _____



3. Match the tire load range ratings to their correct descriptions.

____ a. 4 ply with 8 ply rating; 8 ply

1. B

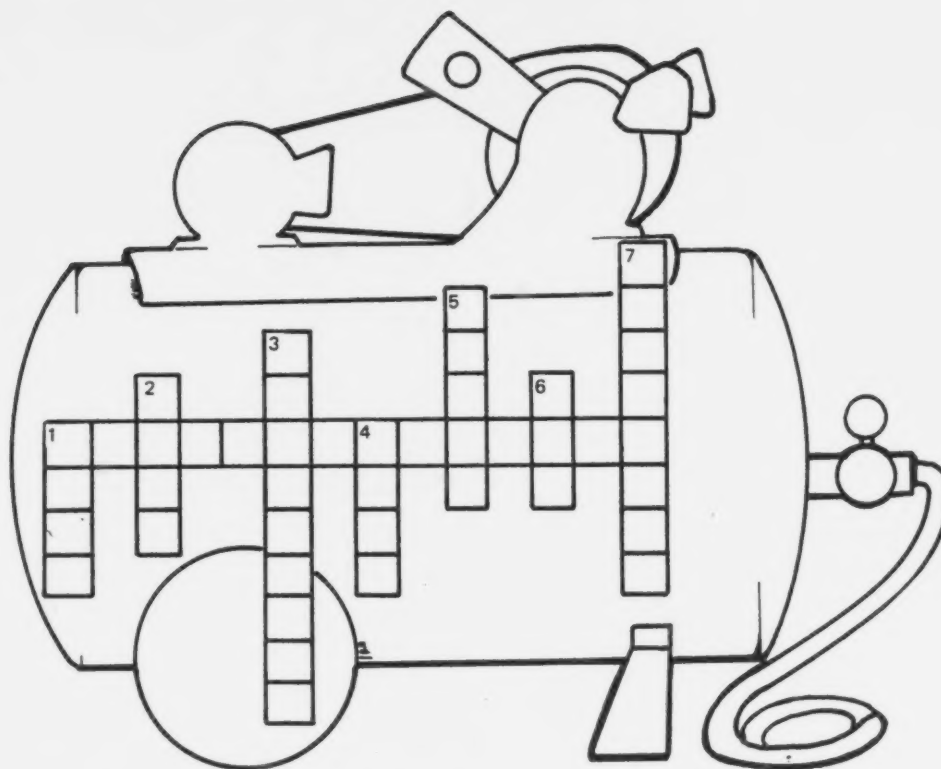
____ b. 2 ply with 4 ply rating; 4 ply

2. C

____ c. 6 ply

3. D

4. Discuss tire inflation by completing the crossword puzzle below.



- a. Tire (7 Down) should be checked when (4 Down)
- b. Tire pressure should be the (1 Down) as the vehicle manufacturer's (1 Across)
- c. Tire pressure may vary from vehicle specifications only to correct tire (2 Down) due to (3 Down) pressures
- d. Tire pressure should be checked each (5 Down) or sooner if inspection indicates a (6 Down) condition

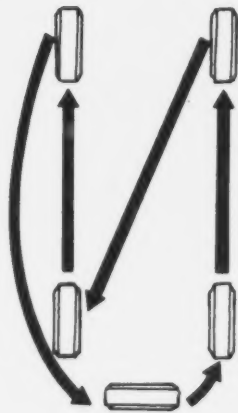
5. List reasons for periodic tire rotation by placing an "X" beside each correct reason.

- ___ a. Allows for close tire inspection
- ___ b. Permits tire pressure adjustment
- ___ c. Minimizes the possibility of tire noise
- ___ d. Equalizes tire wear
- ___ e. Prevents blow-outs
- ___ f. Allows outside tread surfaces to be turned to the inside

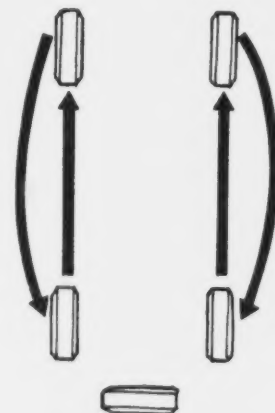
6. Identify the tire rotation patterns shown by writing the correct term under each pattern.

Bias-ply (4 tires)
Bias-ply (5 tires)

Radial-ply (4 tires)
Radial-ply (5 tires)



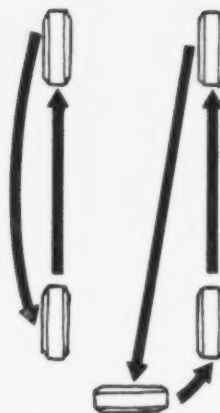
a. _____



b. _____



c. _____



d. _____

7. Name three methods of repairing minor tire punctures by unscrambling the terms below.

O T H P H A C T

a. _____

C L O D P H A C T

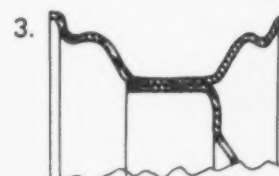
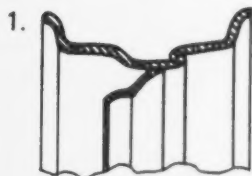
b. _____

B R E B R U G L U P

c. _____

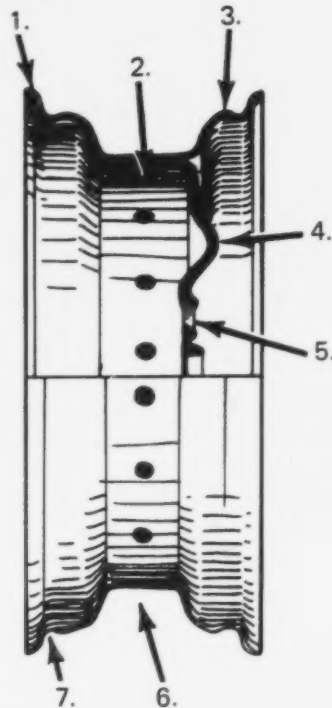
8. Identify the following types of wheels by placing the correct numbers in the blanks provided.

- _____ a. Drop center
 _____ b. Two piece split rim
 _____ c. Three piece split rim



9. Identify the parts of the drop center wheel in the drawing below. Place the correct numbers in the blanks provided.

- _____ a. Flange
- _____ b. Rivet
- _____ c. Center section
- _____ d. Safety ridge
- _____ e. Mounting hole
- _____ f. Tire bead seat area
- _____ g. Drop center area



10. Stop. Have your instructor evaluate your Assignment Sheet and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

- | | |
|-----------------------|------------|
| _____ I (Part B; 1-t) | _____ XII |
| _____ VIII | _____ XIII |
| _____ IX | _____ XIV |
| _____ X | _____ XV |
| _____ XI | |

If any of the above areas is marked, study the required sections and then go to LAP Step 9. Otherwise, proceed to LAP Step 10.

TIRES AND WHEELS
UNIT II

LAP ASSIGNMENT SHEET #4--TIRE RATINGS AND WHEEL DESIGN

NAME _____ SCORE _____

1. Define the following terms.

- a. Aspect ratio -- _____

- b. Drop center wheel -- _____

- c. Inner tube -- _____

- d. Rim diameter -- _____

- e. Tire load range -- _____

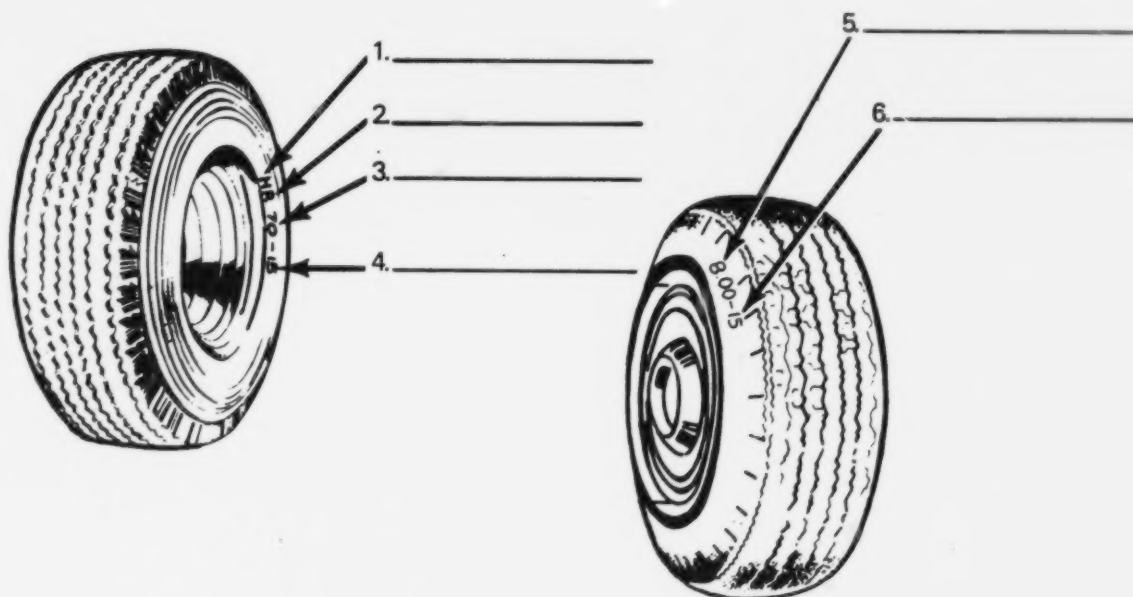
- f. Tire size range -- _____

- g. Tubeless tire -- _____

h. Valve core -- _____

i. Valve stem -- _____

2. Explain what the tire markings in the drawings below mean.



3. Complete the following chart by writing the correct tire ply rating in the spaces provided.

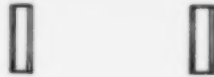
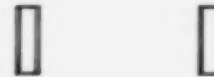
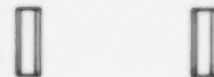
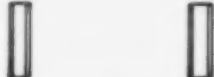
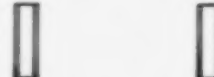
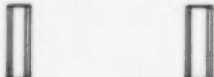
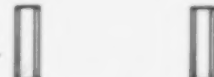
Load Range	Tire Ply Rating
B	2 ply with 4 ply rating; 4 ply
C	6 ply
D	4 ply with 8 ply rating; 8 ply

4. Discuss tire inflation pressure.

5. List three reasons for periodic tire rotation.

- a.
- b.
- c.

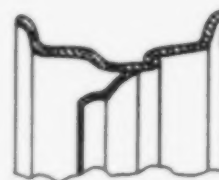
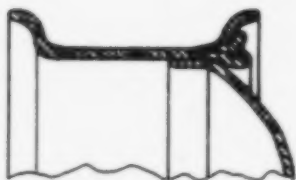
6. Draw tire rotation patterns for the following types of tires. Place arrows showing the direction of movement.

			
			
4 Tires	5 Tires	4 Tires	5 Tires
Bias-Ply Tires		Radial-Ply Tires	

7. List three methods of repairing minor tire punctures.

- a.
- b.
- c.

8. Identify the following types of wheels.

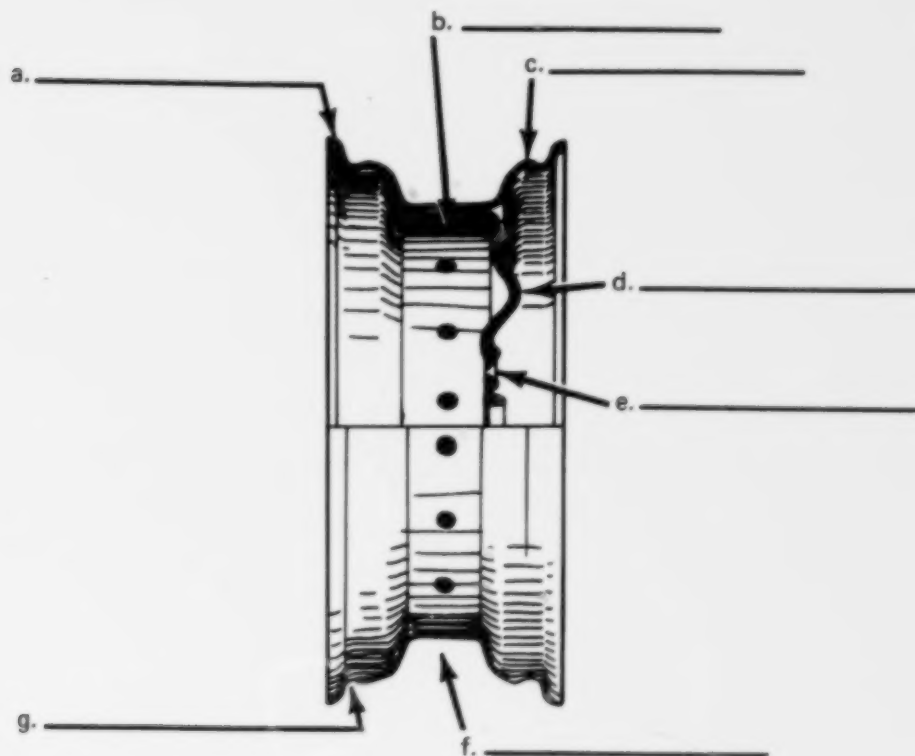


a. _____

b. _____

c. _____

9. Identify the parts of the drop center wheel in the drawing below.



10. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, continue to LAP Step 10. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 10.

**State Department
of
Vocational and Technical
Education
CIMC
Stillwater, Oklahoma
LEARNING ACTIVITY
PACKETS**

for AUTO MECHANICS I

MAJOR INSTRUCTIONAL AREA

SUSPENSION

INSTRUCTIONAL UNIT

WHEEL BALANCING

LEARNING ACTIVITY PACKET NO.

18

PREREQUISITE LAP(S)

1, 2, 9

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Wheel Balancing." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to identify types of wheel balancers, state reasons for balancing wheels, check tire and wheel runout, and balance a tire and wheel assembly.

TASKS INCLUDED IN THIS LAP:

1. Check tire and wheel runout.
2. Static balance a tire and wheel assembly.
3. Spin balance a tire and wheel assembly on the car.

AUTO MECHANICS I
WHEEL BALANCING
SECTION D--UNIT III

LEARNING STEPS

Check the Following
Blanks as You Complete
Each Required Step

- ____ 1. Read Unit and Specific Objectives, page 97-D.
- ____ 2. Complete Wheel Balancing Pre-Test, LAP page 5.
- ____ 3. Study The Sections of the Information Sheet, pages 101-D and 102-D, indicated by your instructor on your Pre-Test. Be sure to study the transparency masters when required.
- ____ 4. Do LAP Assignment Sheet #1, LAP page 9.
- ____ 5. Do LAP Assignment Sheet #2, LAP page 13.
- ____ 6. Check The tasks below which you feel that you can do without supervision.

Student
Check

Instructor
Initials/Date

		Skilled	Moderately Skilled
____ a.	Check tire and wheel runout (9).	_____	_____
____ b.	Static balance a tire and wheel assembly (15).	_____	_____
____ c.	Spin balance a tire and wheel assembly on the car (21).	_____	_____

- ____ 7. Discuss Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If all tasks have been initialed, proceed to Step 27. Otherwise, continue to Step 8.
- ____ 8. Refer To Step 6a. If this task has been initialed, proceed to Step 14. Otherwise, continue to Step 9.
- ____ 9. Study Job Sheet #1--Check Tire and Wheel Runout, page 111-D.
- ____ 10. Watch Slide/tape presentation "Check Tire and Wheel Runout" (D-III-1).
- ____ 11. Do Job Sheet #1--Check Tire and Wheel Runout.
- ____ 12. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and proceed to Step 14. Otherwise, repeat Steps 9-11 and then go to Step 13.
- ____ 13. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and continue to Step 14. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6a and continue to Step 14.
- ____ 14. Refer To Step 6b. If this task has been initialed, proceed to Step 20. Otherwise, continue to Step 15.
- ____ 15. Study Job Sheet #2--Static Balance a Tire and Wheel Assembly, page 115-D.

- ____ 16. Watch Slide/tape presentation "Static Balance a Tire and Wheel Assembly" (D-III-2).
- ____ 17. Do Job Sheet #2--Static Balance a Tire and Wheel Assembly.
- ____ 18. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and proceed to Step 20. Otherwise, repeat Steps 15-17 and then go to Step 19.
- ____ 19. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and continue to Step 20. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6b and continue to Step 20.
- ____ 20. Refer To Step 6c. If this task has been initialed, proceed to Step 26. Otherwise, continue to Step 21.
- ____ 21. Study Job Sheet #3--Spin Balance a Tire and Wheel Assembly on the Car, page 117-D.
- ____ 22. Watch Slide/tape presentation "Spin Balance a Tire and Wheel Assembly on the Car" (D-III-3).
- ____ 23. Do Job Sheet #3 -- Spin Balance a Tire and Wheel Assembly on the Car.
- ____ 24. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6c and proceed to Step 26. Otherwise, repeat Steps 21-23 and then go to Step 25.

- ____ 25. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6c and continue to Step 26. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6c and continue to Step 26.
- ____ 26. Refer To Step 6. If all tasks have been initialed, continue to Step 27. Otherwise, go to the step indicated in parentheses after the unsigned task.
- ____ 27. Review Information Sheet, pages 101-D and 102-D.
- ____ 28. Take Wheel Balancing Unit II Test (see your instructor). If you achieve a score of 85 percent or more, continue to the next assigned Learning Activity Packet. Otherwise, discuss additional study requirements and possible re-testing with your instructor.

WHEEL BALANCING
UNIT III
PRE-TEST

NAME _____ SCORE _____

DIRECTIONS: This test is to determine how much you already know about wheel balancing. Your performance on this test will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. Answer only those questions for which you are certain of the answer. Guessing may prevent you from receiving the lessons which are required.

1. Match the terms on the right to their correct definitions.

- | | | | |
|----------|--|----|-----------------------|
| _____ a. | Small wedges used to align wheels true | 1. | Tire and wheel runout |
| _____ b. | Placement of wheel weights around the wheel rim to counteract the centrifugal forces acting upon heavy areas of the tire and wheel assembly that would keep the tire from rolling smooth | 2. | Wheel weight |
| _____ c. | Lead bar attached to the wheel as a counter balance | 3. | Tire tramp |
| _____ d. | Circumference of inflated tire mounted on the wheel | 4. | Wheel shimmy |
| _____ e. | Hopping motion of the tire and wheel assembly due to an out-of-balance condition | 5. | Wheel balancing |
| _____ f. | Violent back-and-forth shaking of the steering wheel caused by rapid side-to-side whipping of the front tires | | |
| _____ g. | Amount of trueness that the tire or wheel rotates with respect to lateral movement (wobble) and radial movement (difference between high and low points of trade or rim flange) | | |
| _____ h. | Procedure to make all four tire and wheel assemblies the same weight | | |

2. List five advantages of balancing wheels.

a.

b.

c.

d.

e.

3. Discuss the types of wheel balance.

a. Static balance

b. Dynamic balance

4. List six conditions which would require rebalancing of the wheel.

a.

b.

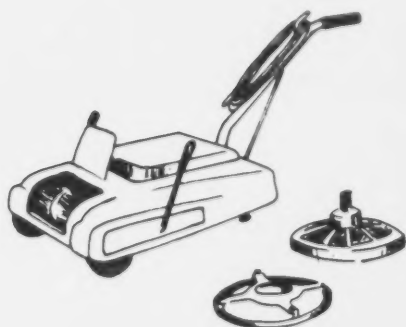
c.

d.

e.

f.

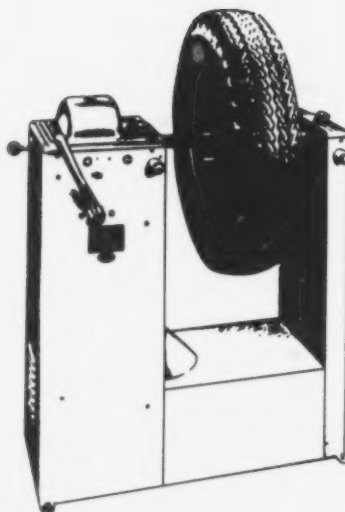
5. Identify the types of balancers in the drawings below by writing the correct name in the blanks provided.



a. _____



b. _____



c. _____

6. Discuss the types of wheel weights and their uses.
 - a. Clip-on
 - b. Tape-on
7. Stop. Have your instructor evaluate your Pre-Test and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

_____ I	_____ IV
_____ II	_____ V
_____ III	_____ VI

You came here from LAP Step 2. If any of the above areas is marked, continue to LAP Step 3. Otherwise, proceed to LAP Step 6.

WHEEL BALANCING
UNIT III

LAP ASSIGNMENT SHEET #1--WHEEL BALANCING

NAME _____

SCORE _____

1. Match the terms on the right to their correct definition.

- | | |
|--|---------------------------------|
| <p>_____ a. Placement of wheel weights around the wheel rim to counteract the centrifugal forces acting upon heavy areas of the tire and wheel assembly that would keep the tire from rolling smooth</p> | <p>1. Tire tramp</p> |
| <p>_____ b. Lead bar attached to the wheel as a counter balance</p> | <p>2. Wheel shimmy</p> |
| <p>_____ c. Hopping motion of the tire and wheel assembly due to an out-of-balance condition</p> | <p>3. Wheel weight</p> |
| <p>_____ d. Violent back-and-forth shaking of the steering wheel caused by rapid side-to-side whipping of the front tires</p> | <p>4. Tire and wheel runout</p> |
| <p>_____ e. Amount of trueness that the tire or wheel rotates with respect to lateral movement (wobble) and radial movement (difference between high and low points of tread or rim flange)</p> | <p>5. Wheel balancing</p> |

2. List the advantages of balancing wheels by completing the following statements.

- a. Provides greater vehicle _____ by keeping the tires on the pavement.
- b. Reduces the _____.
- c. Reduces excessive _____ wear.
- d. Eliminates wheel _____.

3. Identify the two types of balancing described below.

- a. _____ -- Balancing a tire at rest by adding a compensating weight to offset a heavy area of the tire

- b. _____ -- Balancing a wheel in motion so that the center line of the weight of the revolving tire is in the same plane as the center line of the tire
4. List conditions which require rebalancing of the wheel by completing the following statements.
- Loss of a wheel _____.
 - Mounting of _____.
 - _____ of tires.
 - _____ tire.
 - Abnormal tire _____ that causes a change in the tire.
 - Every _____ miles.
5. Identify the types of balancers in the drawings below by writing the correct names in the blanks provided.

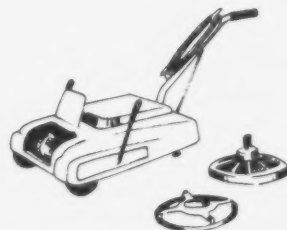
On-the-car spin

Static

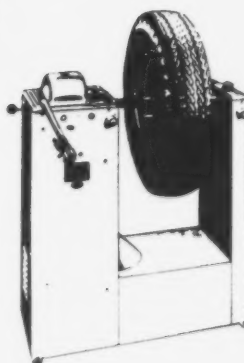
Off-the car spin



a. _____



b. _____



c. _____

6. Identify the two types of wheel weights described below.

- a. _____ -- Wheel weight with a spring steel attaching clip used on standard steel wheels
- b. _____ -- Wheel weight with an attaching adhesive on the back to use on chrome, magnesium, and aluminum wheels

7. Stop. Have your instructor evaluate your Assignment Sheet and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

_____ I _____ IV

_____ II _____ V

_____ III _____ VI

If any of the above areas is marked, study the required sections and then go to LAP Step 5. Otherwise, proceed to LAP Step 6.

WHEEL BALANCING
UNIT III

LAP ASSIGNMENT SHEET #2--WHEEL BALANCING

NAME _____ SCORE _____

1. Define the following terms.

- a. Tire and wheel runout -- _____

- b. Tire tramp -- _____

- c. Wheel balancing -- _____

- d. Wheel shimmy -- _____

- e. Wheel weight -- _____

2. List five advantages of balancing wheels.

- a.
b.
c.
d.
e.

3. Name and describe the two methods of balancing wheels.

4. State six conditions which would require rebalancing of the wheel.

a.

b.

c.

d.

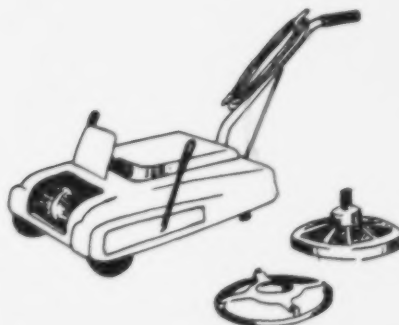
e.

f.

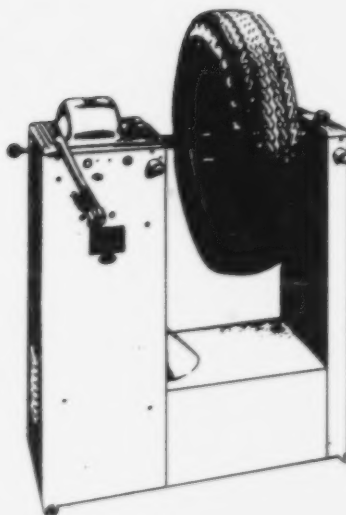
5. Identify the types of balancers in the drawings below.



a. _____



b. _____



c. _____

6. Name and discuss types of wheel weights and their uses.

7. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, continue to LAP Step 6. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 6.

**State Department
of
Vocational and Technical
Education
CIMC
Stillwater, Oklahoma
LEARNING ACTIVITY
PACKETS**

for AUTO MECHANICS I

MAJOR INSTRUCTIONAL AREA

SUSPENSION

INSTRUCTIONAL UNIT

SUSPENSION SYSTEM
SECTION D--UNIT IV

LEARNING ACTIVITY PACKET NO.

19

PREREQUISITE LAP(S)

1

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Suspension System." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to state the purpose of the suspension system, define terms associated with the system, and identify parts of the system. Additionally, the student should become able to inspect and repair system components.

TASKS INCLUDED IN THIS LAP:

1. Inspect and replace shock absorbers.
2. Inspect a front suspension for wear.
3. Repair an upper control arm assembly on a lower control arm mounted coil spring.
4. Repair a lower control arm assembly on a lower control arm mounted spring.

AUTO MECHANICS I
SUSPENSION SYSTEM
SECTION D--UNIT IV

LEARNING STEPS

Check the Following
Blanks as You Complete
Each Required Step.

- ____ 1. Read Unit and Specific Objectives, page 125-D.
- ____ 2. Complete Suspension system Pre-Test, LAP page 7.
- ____ 3. Study The Sections of the Information Sheet, pages 129-D through 131-D, indicated by your instructor on your Pre-Test. Be sure to study the transparency masters when required.
- ____ 4. Do LAP Assignment Sheet #1, LAP page 11.
- ____ 5. Do LAP Assignment Sheet #2, LAP page 15.
- ____ 6. Check The tasks below which you feel that you can do without supervision.

Student
Check

Instructor
Initials/Date

		Skilled	Moderately Skilled
____ a.	Inspect and replace shock absorbers (9).	_____	_____
____ b.	Inspect a front suspension for wear (15).	_____	_____
____ c.	Repair an upper control arm assembly on a lower control arm mounted coil spring (21).	_____	_____

- ____ d. Repair a lower control arm assembly on a lower control arm mounted spring (27). _____
- ____ 7. Discuss Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If all tasks have been initialed, proceed to Step 33. Otherwise, continue to Step 8.
- ____ 8. Refer To Step 6a. If this task has been initialed, proceed to Step 14. Otherwise, continue to Step 9.
- ____ 9. Study Job Sheet #1--Inspect and Replace Shock Absorbers, page 149-D.
- ____ 10. Watch Slide/tape presentation "Inspect and Replace Shock Absorbers" (D-IV-I).
- ____ 11. Do Job Sheet #1--Inspect and Replace Shock Absorbers.
- ____ 12. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and proceed to Step 14. Otherwise, repeat Steps 9-11 and then go to Step 13.
- ____ 13. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and continue to Step 14. If additional study is required, discuss a program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6a and continue to Step 14.
- ____ 14. Refer To Step 6b. If this task has been initialed, proceed to Step 20. Otherwise, continue to Step 15.

- ____ 15. Study Job Sheet #2--Inspect a Front Suspension for Wear, page 155-D.
- ____ 16. Watch Slide/tape presentation "Inspect a Front Suspension for Wear" (D-IV-2).
- ____ 17. Do Job Sheet #2--Inspect a Front Suspension for Wear.
- ____ 18. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and proceed to Step 20. Otherwise, repeat Steps 15-17 and then go to Step 19.
- ____ 19. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and continue to Step 20. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6b and continue to Step 20.
- ____ 20. Refer To Step 6c. If this task has been initialed, proceed to Step 26. Otherwise, continue to Step 21.
- ____ 21. Study Job Sheet #3--Repair an Upper Control Arm Assembly on a Lower Control Arm Mounted Coil Spring, page 159-D.
- ____ 22. Watch Slide/tape presentation "Repair an Upper Control Arm Assembly on a Lower Control Arm Mounted Coil Spring" (D-IV-3).
- ____ 23. Do Job Sheet #3--Repair an Upper Control Arm Assembly on a Lower Control Arm Mounted Coil Spring.
- ____ 24. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6c and proceed to Step 26. Otherwise, repeat Steps 21-23 and then go to Step 25.

- ____ 25. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6c and continue to Step 26. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6c and continue to Step 26.
- ____ 26. Refer To Step 6d. If this task has been initialed, proceed to Step 27.
- ____ 27. Study Job Sheet #4--Repair a Lower Control Arm Assembly on a Lower Control Arm Mounted Spring, page 165-D.
- ____ 28. Watch Slide/tape presentation "Repair a Lower Control Arm Assembly on a Lower Control Arm Mounted Spring" (D-IV-4).
- ____ 29. Do Job Sheet #4--Repair a Lower Control Arm Assembly on a Lower Control Arm Mounted Spring.
- ____ 30. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6d and proceed to Step 32. Otherwise, repeat Steps 27-29 and then go to Step 31.
- ____ 31. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6d and continue to Step 32. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6d and continue to Step 32.
- ____ 32. Refer To Step 6. If all tasks have been initialed, continue to Step 33. Otherwise, go to the step indicated in parentheses after the unsigned tasks.

____ 33. Review Information Sheet, page 129-D.

____ 34. Take Suspension System Unit IV (see your instructor). If you achieve a score of 85 percent or more, continue to the next assigned Learning Activity Packet. Otherwise, ask your instructor about additional training requirements and possible retesting.

SUSPENSION SYSTEM
UNIT IV
PRE-TEST

NAME _____ SCORE _____

DIRECTIONS: This test is to determine how much you already know about the suspension system. Your performance on this test will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. Answer only those questions for which you are certain of the answer. Guessing may prevent you from receiving the lessons which are required.

1. State the purposes of the suspension system.

a.

b.

2. Define the following terms.

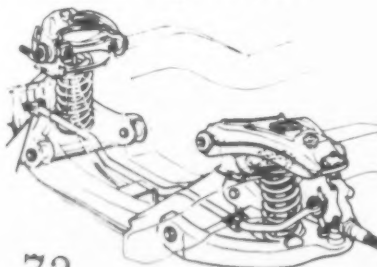
a. Stabilizer bar -- _____

b. Short-long arm type suspension -- _____

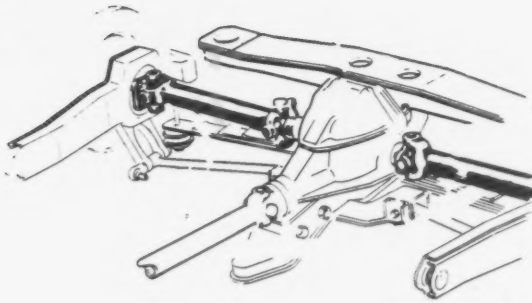
c. Sprung weight -- _____

d. Shock absorber -- _____

3. Identify the suspension systems in the drawings below.



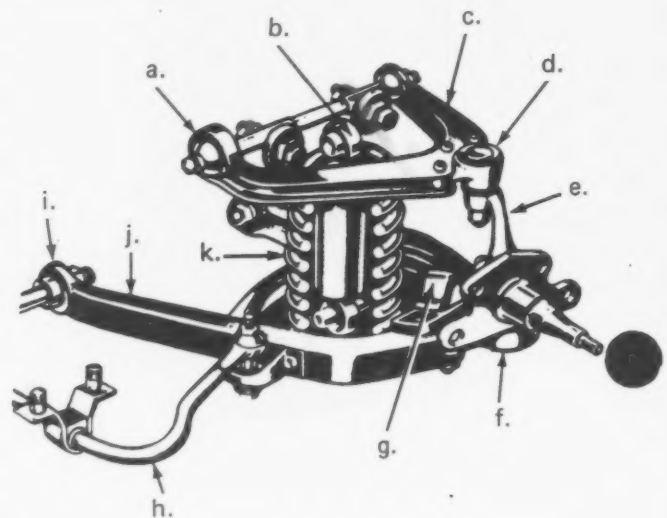
a. _____



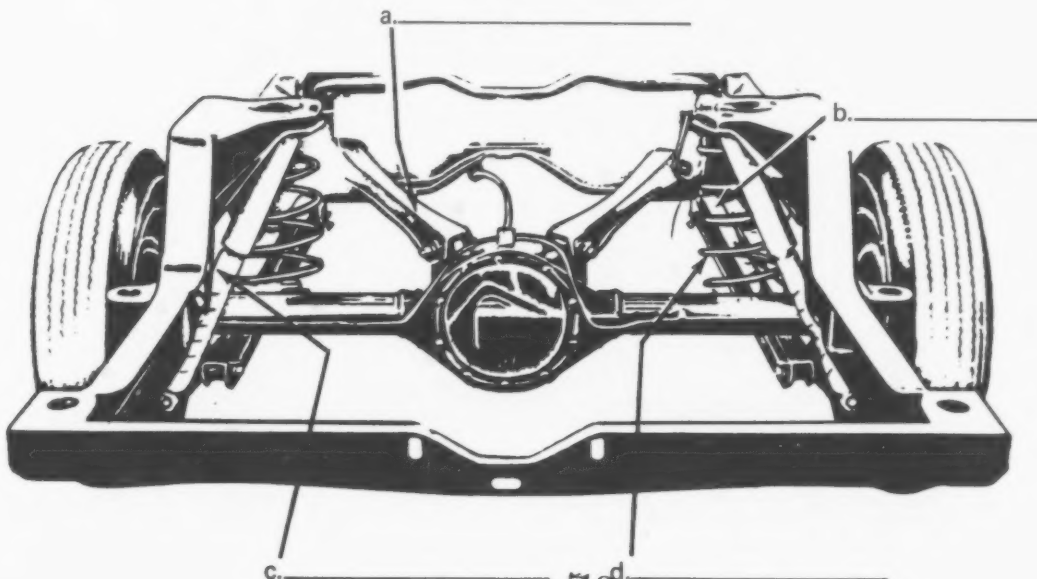
b. _____

4. Identify the parts of the suspension system in the drawing below.

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____
- f. _____
- g. _____
- h. _____
- i. _____
- j. _____
- k. _____



5. Identify the parts of the suspension system in the drawing below.



6. Discuss the four types of suspension springs.

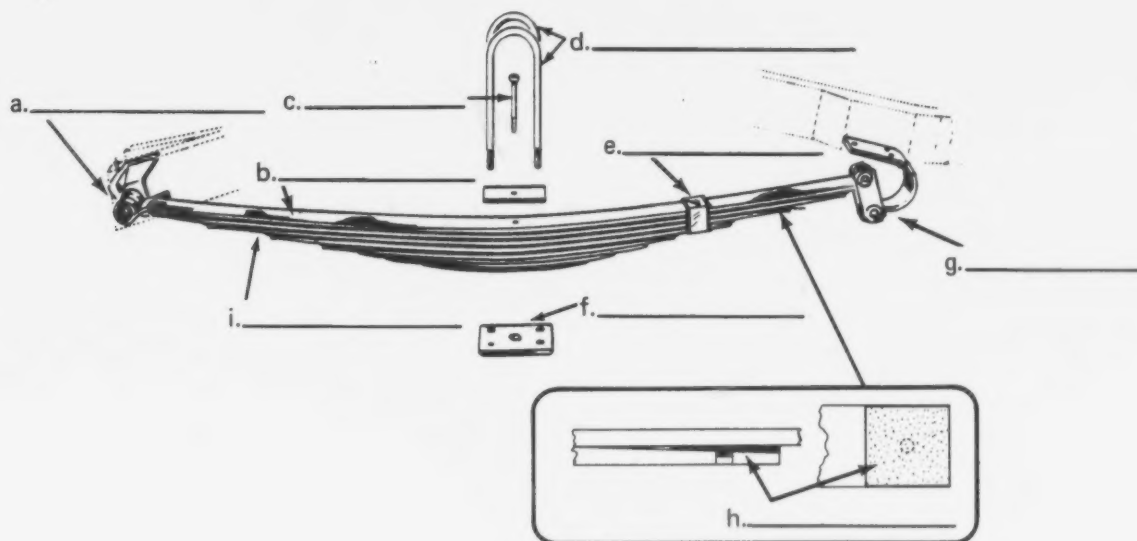
a. Semielliptical leaf spring --

b. Coil spring --

c. Torsion bar --

d. Air spring --

7. Identify the parts of the leaf spring in the drawing below.



8. Stop. Have your instructor evaluate your Pre-Test and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

☐ I
☐ II
☐ III
☐ IV

☐ V
☐ VI
☐ VII

You came here from LAP Step 2. If any of the above areas is checked, continue to LAP Step 3. Otherwise, proceed to LAP Step 6.

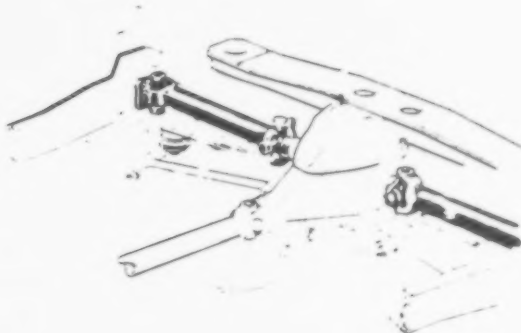
SUSPENSION SYSTEM
UNIT IV

LAP ASSIGNMENT SHEET #1--SUSPENSION SYSTEM

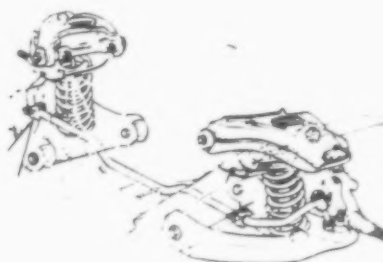
NAME _____ SCORE _____

1. State the two purposes of the suspension system by completing the following statements.
 - a. To allow the vehicle to travel over _____ surfaces with a minimum amount of _____ movement to the body.
 - b. To allow the vehicle to corner with minimum _____ or tendency to break _____ between tire and road.
2. Match the terms on the right to their correct definitions.

_____ a. Transverse mounted spring steel bar that minimizes body lean or tipping when cornering	1. Sprung weight
_____ b. Suspension system utilizing two control arms, with the upper arm shorter than the lower to allow the wheel to deflect up and down with a minimum change in camber	2. Stabilizer bar
_____ c. Hydraulic piston and cylinder device with one end attached to the frame and the other end attached to the axle to dampen or restrict the up-down movement of the springs	3. Shock absorber
_____ d. Weight of all vehicle parts supported by the springs	4. S.L.A. type suspension
3. Identify the suspension systems shown below.



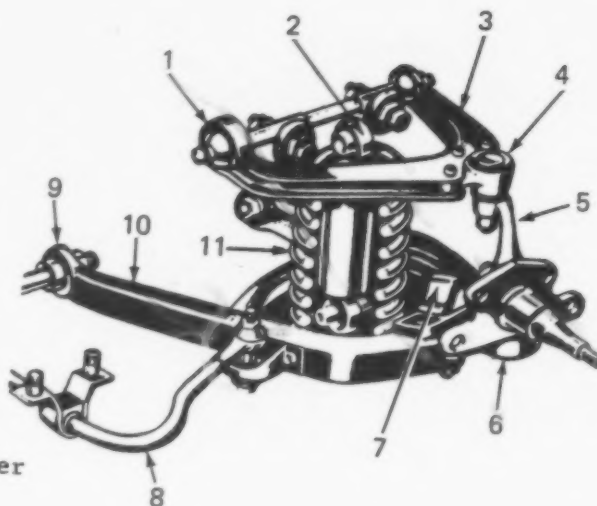
a. _____



b. _____

4. Identify the parts of the suspension system in the diagram below by placing the correct numbers in the blanks provided.

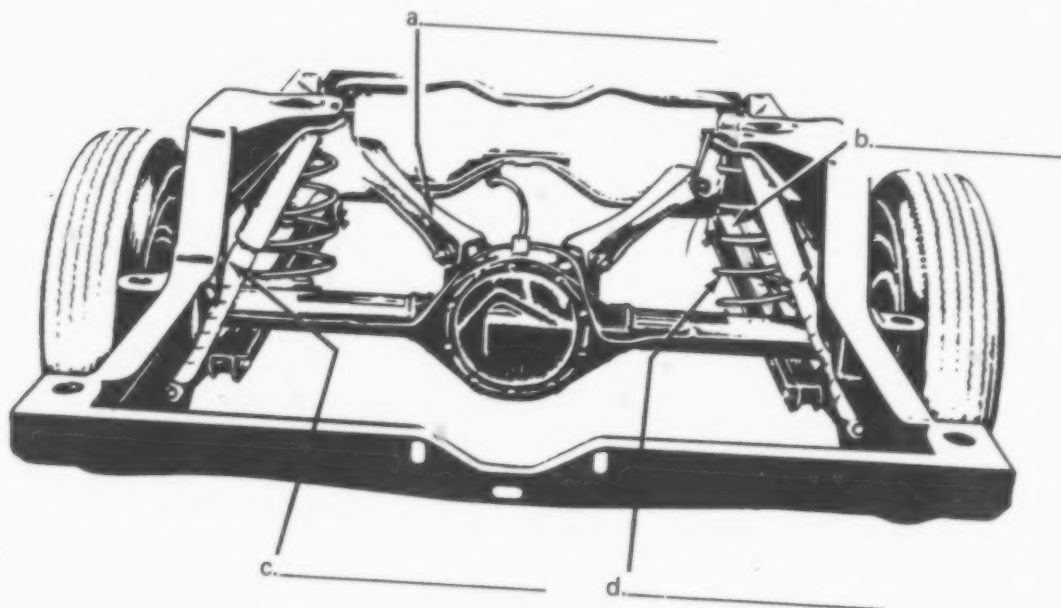
- ___ a. Upper control arm (short arm)
- ___ b. Coil spring
- ___ c. Upper ball joint
- ___ d. Shock absorber
- ___ e. Lower ball joint
- ___ f. Lower control arm (long arm)
- ___ g. Steering knuckle
- ___ h. Rubber bumper
- ___ i. Stabilizer bar
- ___ j. Lower control arm inner bushings and shaft
- ___ k. Upper control arm inner bushings



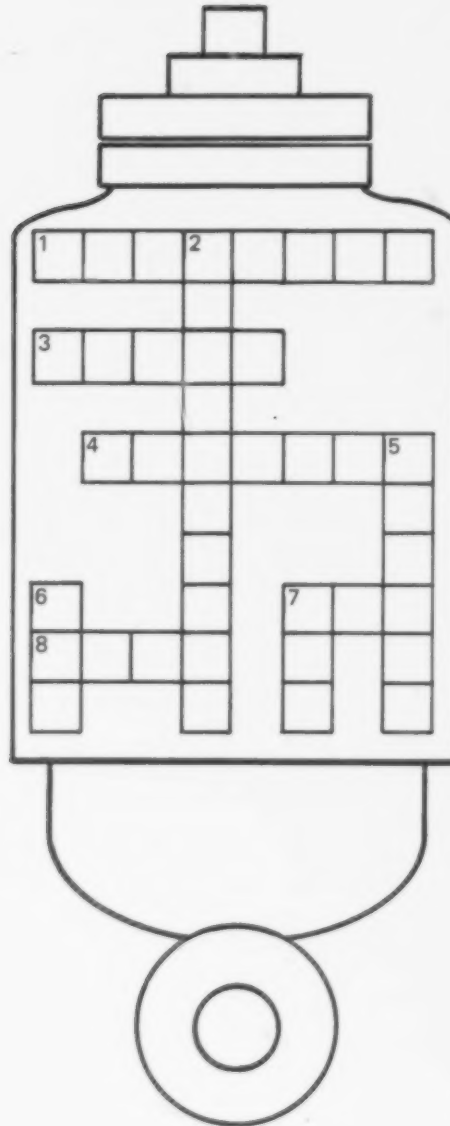
5. Identify the parts of the suspension system in the diagram below by writing the correct names in the blanks provided.

Lower control arm
Upper control arm

Coil spring
Shock absorber



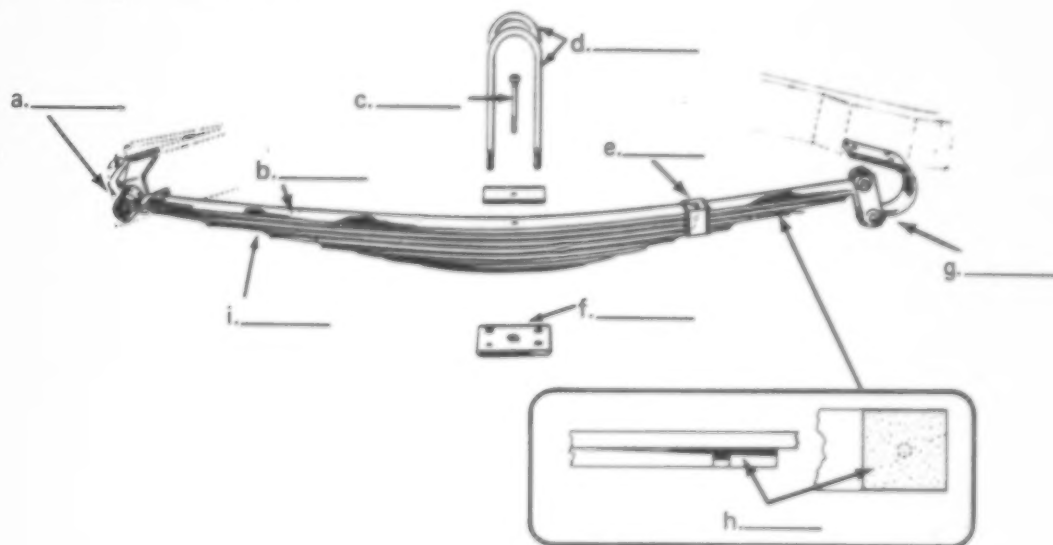
6. Discuss types of suspension springs by completing the crossword puzzle below.



- a. Semielliptical leaf spring -- A number of flat steel (4 Across) of varying length bolted together in the center to make a single unit and attached to the vehicle body at each end by (1 Across) and to the (8 Across) by V-bolts.
- b. Coil spring -- Special steel spring rod wound into a (5 Down) coil, with one end secured to the frame and the other to the axle or control (7 Down).

- c. Torsion bar -- Relatively long spring steel (6 Down) that has one end attached to the lower control arm which twists the bar to allow the vehicle body to move up and down.
- d. Air spring -- Cylinder and plunger separated by (2 Down) (7 Across) and placed between the axle and frame of the vehicle to provide a spring or cushion for the body of the vehicle.
7. Identify the parts of the leaf spring in the diagram below by placing the correct numbers in the blanks provided.

- | | |
|---------------------|------------------|
| 1. Main leaf | 6. Center bolt |
| 2. Leaf pad | 7. U-bolt plate |
| 3. Rebound clamp | 8. U-bolts |
| 4. Shackle assembly | 9. Leaf assembly |
| 5. Hanger assembly | |



8. Stop. Have your instructor evaluate your Assignment Sheet and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

- | | |
|-------------------|-------------------|
| <u> </u> I | <u> </u> V |
| <u> </u> II | <u> </u> VI |
| <u> </u> III | <u> </u> VII |
| <u> </u> IV | |

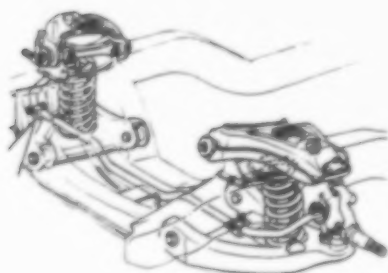
If any of the above areas is checked, continue to LAP Step 5. Otherwise, proceed to LAP Step 6.

SUSPENSION SYSTEM
UNIT IV

LAP ASSIGNMENT SHEET #2--SUSPENSION SYSTEM

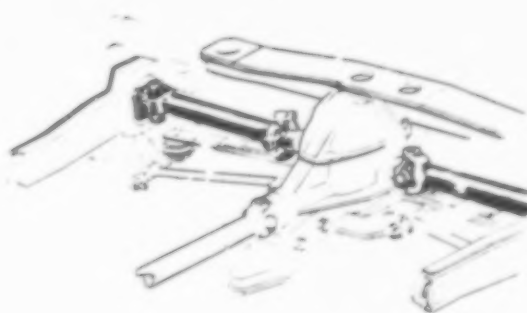
NAME _____ SCORE _____

1. State the two purposes of the suspension system.
 - a.
 - b.
2. Define the terms listed below.
 - a. Stabilizer bar
 - b. S.L.A. type suspension (short-long arm)
 - c. Sprung weight
 - d. Shock absorber
3. Identify the suspension systems in the diagrams below by writing the correct names in the blanks provided.



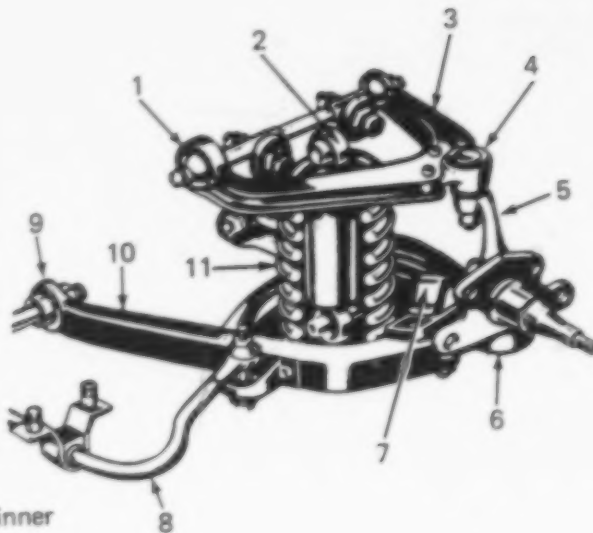
a. _____

b. _____

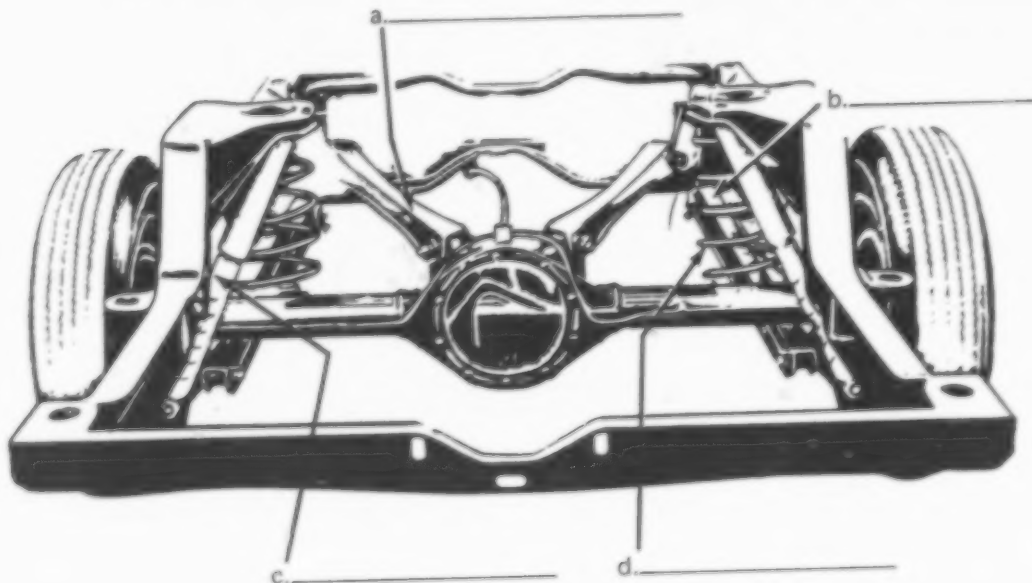


4. Identify the parts of the suspension system in the diagram below by placing the correct numbers in the blanks provided.

- _____ a. Upper control arm (short arm)
- _____ b. Coil spring
- _____ c. Upper ball joint
- _____ d. Shock absorber
- _____ e. Lower ball joint
- _____ f. Lower control arm (long arm)
- _____ g. Steering knuckle
- _____ h. Rubber bumper
- _____ i. Stabilizer bar
- _____ j. Lower control arm inner bushings and shaft
- _____ k. Upper control arm inner bushings



5. Identify the parts of the suspension system in the diagram below by writing the correct names in the blanks provided.



6. Discuss the four types of suspension springs.

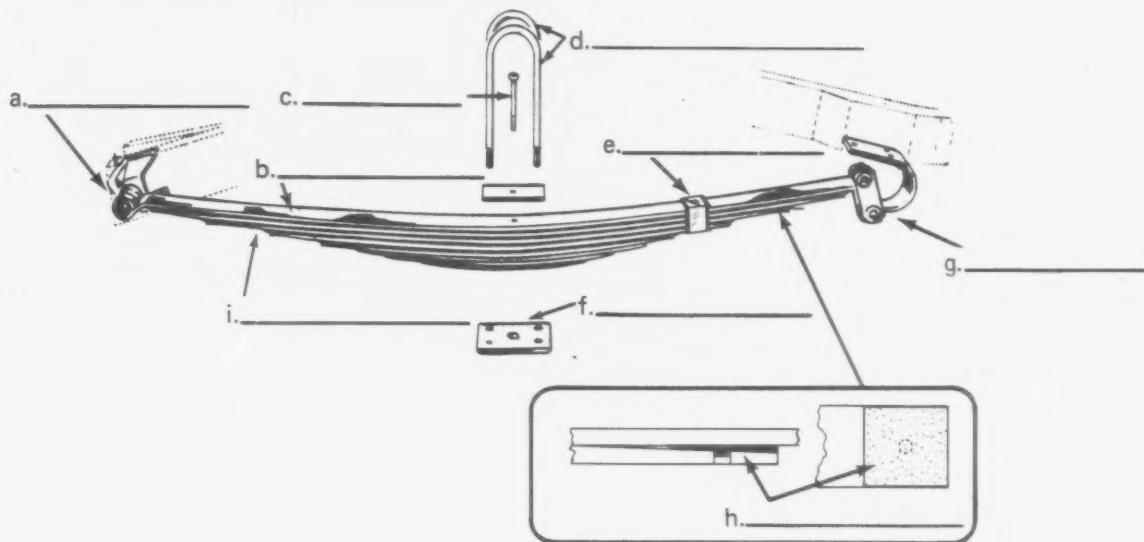
a. Semielliptical leaf spring

b. Coil spring

c. Torsion bar

d. Air Spring

7. Identify the parts of the leaf spring in the diagram below by placing the correct names in the blanks provided.



8. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, continue to LAP Step 6. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 6.

**State Department
of
Vocational and Technical
Education
CIMC
Stillwater, Oklahoma
LEARNING ACTIVITY
PACKETS**

for AUTO MECHANICS I

MAJOR INSTRUCTIONAL AREA

SUSPENSION

INSTRUCTIONAL UNIT

STEERING SYSTEM
SECTION D--UNIT V

LEARNING ACTIVITY PACKET NO.

20

PREREQUISITE LAP(S)

1, 2, 18, 19

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Steering System." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to identify the parts of the steering system; inspect, repair, and adjust a steering system; and service certain steering system components.

TASKS INCLUDED IN THIS LAP:

1. Inspect a steering system for damaged parts or wear.
2. Remove and replace a tie rod end.
3. Pressure test a power steering system.
4. Remove, reseal, and replace a power steering pump.
5. Remove, recondition, and replace a recirculating ball type steering gear.

AUTO MECHANICS I
STEERING SYSTEM
SECTION D--UNIT V

LEARNING STEPS

Check the Following
Blanks as You Complete
Each Required Step

- ____ 1. Read Unit and Specific Objectives, page 179-D.
- ____ 2. Complete Steering System Pre-Test, LAP page 7.
- ____ 3. Study The Sections of the Information Sheet, pages 183-D through 185-D, indicated by your instructor on your Pre-Test. Be sure to study the transparency masters when required.
- ____ 4. Do LAP Assignment Sheet #1, LAP page 11.
- ____ 5. Do LAP Assignment Sheet #2, LAP page 15.
- ____ 6. Check The tasks below which you feel you can do without supervision.

Student
Check

Instructor
Initials/Date

		Skilled	Moderately Skilled
____ a.	Inspect a steering system for damaged parts or wear (9).	_____	_____
____ b.	Remove and replace a tie rod end (15).	_____	_____
____ c.	Pressure test a power steering system (21).	_____	_____

- ____ d. Remove, reseal, and replace a power steering pump (27). _____
- ____ e. Remove, recondition, and replace a recirculating ball type steering gear (33). _____
- ____ 7. Discuss Your competency with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If all tasks have been initialed, proceed to Step 39. Otherwise, continue to Step 8.
- ____ 8. Refer To Step 6a. If this task has been initialed, proceed to Step 14. Otherwise, continue to Step 9.
- ____ 9. Study Job Sheet #1--Inspect a Steering System for Damaged Parts or Wear, page 207-D.
- ____ 10. Watch Slide/tape presentation "Inspect a Steering System for Damaged Parts or Wear" (D-V-1).
- ____ 11. Do Job Sheet #1--Inspect a Steering System for Damaged Parts or Wear.
- ____ 12. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and proceed to Step 14. Otherwise, repeat Steps 9-11 and then go to Step 13.
- ____ 13. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and continue to Step 14. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6a and continue to Step 14.

- ____ 14. Refer To Step 6b. If this task has been initialed, proceed to Step 20. Otherwise, continue to Step 15.
- ____ 15. Study Job Sheet #2--Remove and Replace a Tie Rod End, page 213-D.
- ____ 16. Watch Slide/tape presentation "Remove and Replace a Tie Rod End" (D-V-2).
- ____ 17. Do Job Sheet #2--Remove and Replace a Tie Rod End.
- ____ 18. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and proceed to Step 20. Otherwise, repeat Steps 15-17 and then go to Step 19.
- ____ 19. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and continue to Step 20. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6b and continue to Step 20.
- ____ 20. Refer To Step 6c. If this task has been initialed, proceed to Step 26. Otherwise, continue to Step 21.
- ____ 21. Study Job Sheet #3--Pressure Test a Power Steering System, page 215-D.
- ____ 22. Watch Slide/tape presentation "Pressure Test a Power Steering System" (D-V-3).
- ____ 23. Do Job Sheet #3--Pressure Test a Power Steering System.

- ____ 24. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6c and proceed to Step 26. Otherwise, repeat Steps 21-23 and then go to Step 25.
- ____ 25. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6c and continue to Step 26. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6c and continue to Step 26.
- ____ 26. Refer To Step 6d. If this task has been initialed, proceed to Step 32. Otherwise, continue to Step 27.
- ____ 27. Study Job Sheet #4--Remove, Reseal, and Replace a Power Steering Pump, page 219-D.
- ____ 28. Watch Slide/tape presentation "Remove, Reseal, and Replace a Power Steering Pump" (D-V-4).
- ____ 29. Do Job Sheet #4--Remove, Reseal, and Replace a Power Steering Pump.
- ____ 30. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6d and proceed to Step 32. Otherwise, repeat Steps 27-29 and then go to Step 31.
- ____ 31. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6d and continue to Step 32. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6d and continue to Step 32.

- ____ 32. Refer To Step 6e. If this task has been initialed, proceed to Step 38. Otherwise, continue with Step 33.
- ____ 33. Study Job Sheet #5--Remove, Recondition, and Replace a Recirculating Ball Type Steering Gear, page 223-D.
- ____ 34. Watch Slide/tape presentation "Remove, Recondition, and Replace a Recirculating Ball Type Steering Gear" (D-V-5).
- ____ 35. Do Job Sheet #5--Remove, Recondition, and Replace a Circulating Ball Type Steering Gear.
- ____ 36. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6e and proceed to Step 38. Otherwise, repeat Steps 33-35 and then go to Step 37.
- ____ 37. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6e and continue to Study 38. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6e and continue to Step 38.
- ____ 38. Refer To Step 6. If all tasks have been initialed, continue to Step 39. Otherwise, go to the step indicated in parentheses after the unsigned task.
- ____ 39. Review The Information Sheet, page 183-D.
- ____ 40. Take Steering System Unit V Test (see your instructor). If you achieve a score of 85 percent or more, continue to the next assigned Learning Activity Packet. Otherwise, discuss additional study requirements and possible re-testing with your instructor.

STEERING SYSTEM
UNIT V
PRE-TEST

NAME _____

SCORE _____

DIRECTIONS: This test is to determine how much you already know about the steering system. Your performance on this test will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. Answer only those questions for which you are certain of the answer. Guessing may prevent you from receiving the lessons which are required.

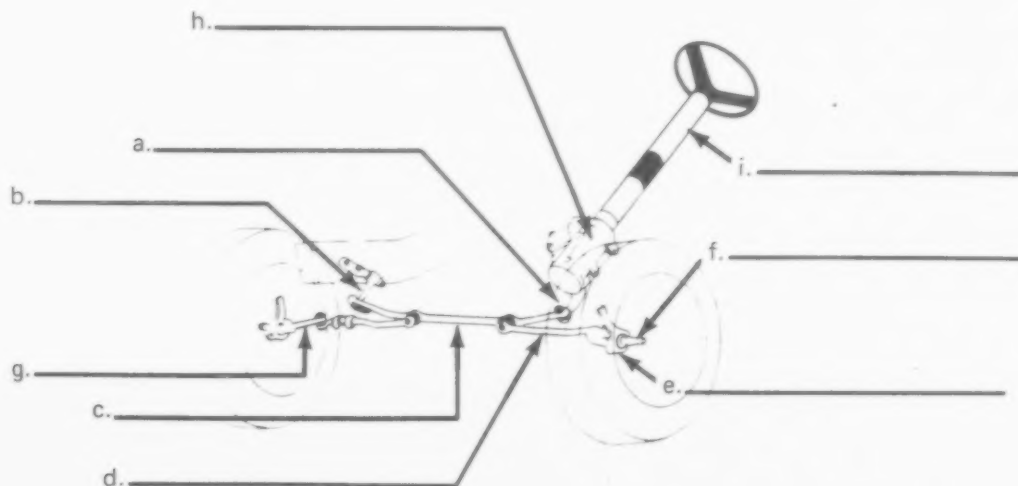
1. Write the purposes of the steering system.

2. Match the terms on the right to the correct definitions. (Definitions are continued on the next page.)

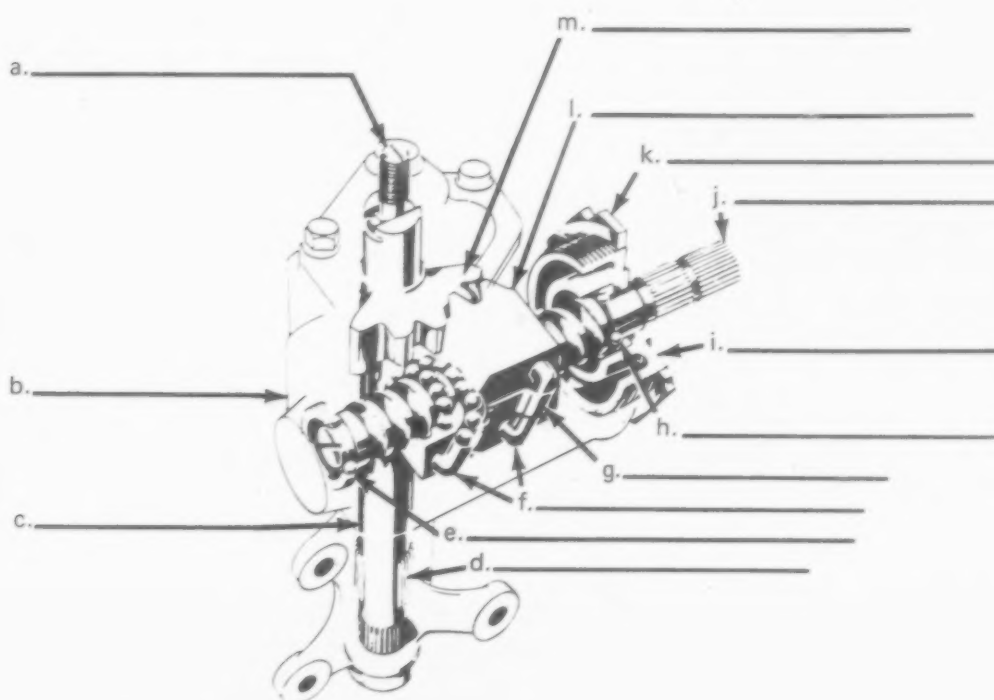
_____ a. Mechanical steering system that provides a hydraulic power assist unit to reduce the driver turning effort	1. Parallelogram steering linkage
_____ b. Power steering system which maintains an equal pressure	2. Ackerman principle
_____ c. Steering column that allows the driver to change the vertical angle of the steering wheel	3. Energy-absorbing steering column
_____ d. Steering gear that has a high ratio at center high point; the ratio decreases as the gear is turned in either direction	4. Power steering
_____ e. Steering column that allows the distance between the steering wheel and the driver to be adjusted	5. Constant ratio power setting
_____ f. Bending the outer ends of the steering arms slightly inward so that when the vehicle is making a turn the inside wheel will turn more sharply than the outer wheel; produces toe-out on turns	6. Telescopic steering column
_____ g. Steering column which adjusts automatically with driver seat adjustment	7. Over center high point
	8. Function-locking or anti-theft steering column
	9. Tilt wheel steering column
	10. Variable ratio power steering

- ____ h. Provides a positive lock on transmission gear selector as well as steering system
- ____ i. Steering gear with a fixed gear ratio throughout the total gear travel
- ____ j. Steering column that will collapse on impact to lessen the possibility of injury to the driver in an accident
- ____ k. Principle which states that outside wheels on a turn rotate faster than inside wheels
- ____ l. Steering system utilizing two short tie rods connected to the steering arms and to a long center link; one end of the link is supported by an idler arm and the other end is attached to the pitman arm to form a parallelogram shape
- ____ m. Worm and sector gears are designed so that at the center of their travel the gear tooth mesh is at its closest tolerance

3. Identify the parts of the steering system illustrated below.



4. Name the steering parts which should be inspected for wear, adjustment, and damage.
 - a.
 - b.
 - c.
 - d.
 - e.
5. List three types of manual steering gears.
 - a.
 - b.
 - c.
6. Identify the parts of the recirculating ball nut and worm manual steering gear in the diagram.



7. List two types of power steering pumps.
 - a.
 - b.
8. Describe the three types of power steering systems.
 - a. Integral
 - b. Linkage-booster
 - c. Semi-integral
9. Stop. Have your instructor evaluate your Pre-Test and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

____ I
____ II
____ III
____ IV

____ V
____ VI
____ VII
____ VIII

You came here from LAP Step 2. If any of the above areas is marked, continue to LAP Step 3. Otherwise, continue to LAP Step 6.

STEERING SYSTEM
UNIT V

LAP ASSIGNMENT SHEET #1--STEERING SYSTEM

NAME _____ SCORE _____

1. Write the purpose of the steering system by completing the following statements.

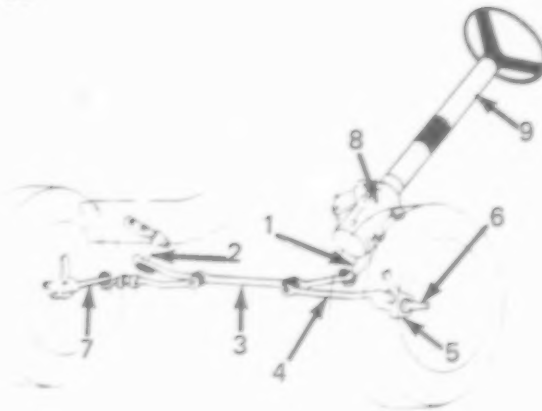
- a. To _____ the front wheels of the vehicle right or left with _____.
- b. To maintain _____ control.

2. Match the terms on the right to the correct definition. (Definitions are continued on the next page.)

- | | |
|---|---|
| _____ a. Mechanical steering system that provides a hydraulic power assist unit to reduce the driver turning effort | 1. Power Steering |
| _____ b. Steering column that allows the driver to change the vertical angle of the steering wheel | 2. Tilt wheel steering column |
| _____ c. Steering gear that has a high ratio at center high point; the ratio decreases as the gear is turned in either direction | 3. Function-locking or anti-theft steering column |
| _____ d. Steering column that allows the distance between the steering wheel and the driver to be adjusted | 4. Ackerman principle |
| _____ e. Bending the outer ends of the steering arms slightly inward so that when the vehicle is making a turn, the inside wheel will turn more sharply than the outer wheel; produces toe-out on turns | 5. Variable ratio power steering |
| _____ f. Provides a positive lock on transmission gear selector as well as steering system | 6. Energy absorbing steering column |
| _____ g. Steering gear with a fixed gear ratio throughout the total gear travel | 7. Constant ratio power steering |
| _____ h. Steering column that will collapse on impact to lessen the possibility of injury to the driver in an accident | 8. Parallelogram steering linkage |
| | 9. Over center high point |
| | 10. Telescope steering column |

- ___ i. Steering system utilizing two short tie rods connected to the steering arms and to a long center link; one end of the link is supported by an idler arm and the other end is attached to the pitman arm to form a parallelogram shape
 - ___ j. Worm and sector gears are designed so that at the center of their travel the gear tooth mesh is at its closet tolerance
3. Identify the parts of the steering system illustrated below by placing the correct numbers in the blanks provided.

- ___ a. Steering spindle bolt
- ___ b. Steering column
- ___ c. Steering gear
- ___ d. Center link or relay link
- ___ e. Idler arm
- ___ f. Tie rod
- ___ g. Pitman arm
- ___ h. Steering knuckle
- ___ i. Steering arm



4. Name five steering parts to inspect for wear, adjustment, or damage by placing an "X" beside each correct choice.
- ___ a. Steering gear
 - ___ b. Steering parallelogram
 - ___ c. Steering column
 - ___ d. Steering linkage
 - ___ e. Ackerman rod
 - ___ f. Wheel bearings
 - ___ g. Pitman knuckle

- ____ h. Steering arm
- ____ i. Transverse tie arm
- ____ j. Steering knuckle

5. List three types of manual steering gears by unscrambling the terms given below.

GRINICULACTER LALB TUN and ROWM

a. _____ and _____

b. ROWM and TROCES

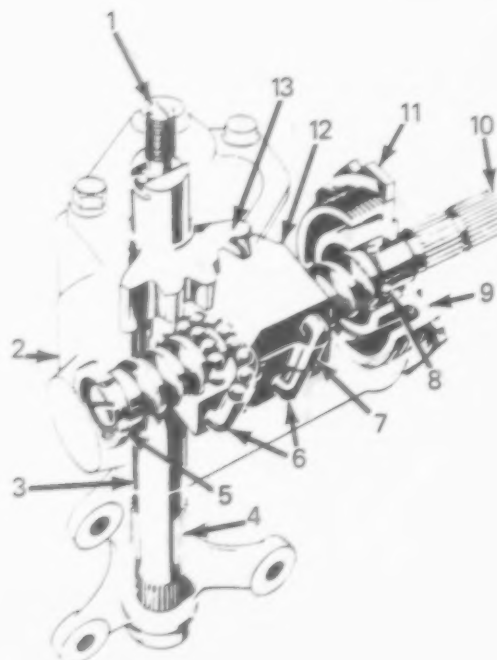
_____ and _____

c. CRAK and NIPNIO

_____ and _____

6. Identify the parts of the recirculating ball nut and worm manual steering gear in the diagram below by placing the correct number in the blank provided.

- ____ a. Steering shaft
- ____ b. Steering shaft bearing adjuster
- ____ c. Ball nut
- ____ d. Sector gear
- ____ e. Sector shaft adjusting screw
- ____ f. Sector shaft
- ____ g. Steering gear housing
- ____ h. Ball return guide
- ____ i. Steering shaft bearing (lower)
- ____ j. Sector shaft bearing
- ____ k. Steering shaft bearing adjuster lock nut
- ____ l. Ball return guide clamp
- ____ m. Steering shaft bearing (upper half)



7. List two types of power steering pumps by placing an "X" beside the correct choices.

- ____ a. Hydropneumatic
 ____ b. Centrifugal displacement
 ____ c. Rotary gear
 ____ d. Vane

8. Match the types of power steering systems to their correct descriptions.

- | | |
|--|--------------------|
| ____ a. Power cylinder attached to the steering linkage; control valve built into the steering housing | 1. Integral |
| ____ b. Power cylinder and control valve mounted on the steering linkage | 2. Semi-integral |
| ____ c. Power cylinder and control valve built into the gear housing | 3. Linkage booster |

9. Stop. Have your instructor evaluate your Assignment Sheet and mark areas below which require additional study.

Refer to Information Sheet, Sections:

- | | |
|----------|-----------|
| ____ I | ____ V |
| ____ II | ____ VI |
| ____ III | ____ VII |
| ____ IV | ____ VIII |

If any of the above areas is marked, study the required section(s) and then go to LAP Step 5. Otherwise, proceed to LAP Step 6.

STEERING SYSTEM
UNIT V

LAP ASSIGNMENT SHEET #2--STEERING SYSTEM

NAME _____

SCORE _____

1. Write the purposes of the steering system.

2. Define the following terms.

a. Ackerman principle -- _____

b. Constant ratio power steering -- _____

c. Energy-absorbing steering column -- _____

d. Function-locking or anti-theft steering column -- _____

e. Over center high point -- _____

- f. Parallelogram steering linkage -- _____

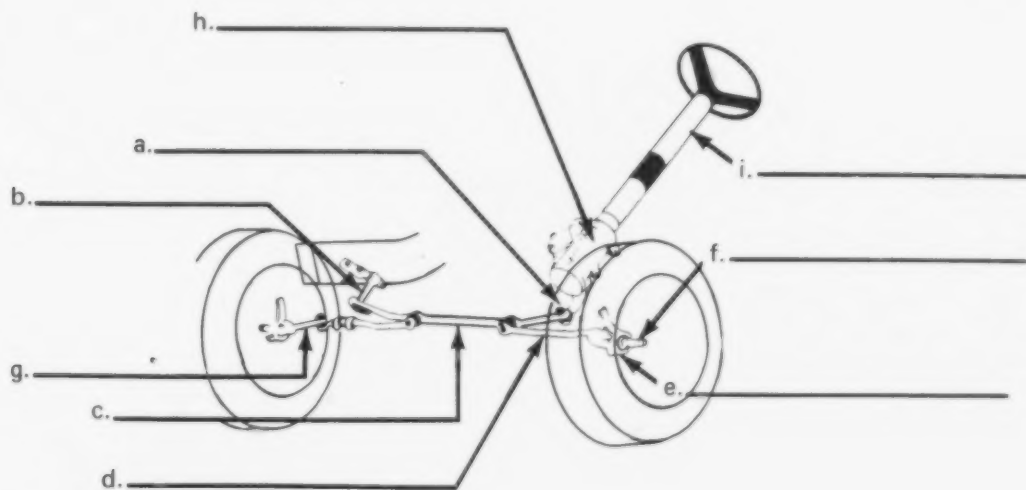
- g. Power steering -- _____

- h. Telescopic steering column -- _____

- i. Tilt wheel steering column -- _____

- j. Variable ratio power steering -- _____

3. Identify the parts of the steering system illustrated below.



4. Name five steering parts which should be inspected for wear, adjustment, and damage.

a.

b.

c.

d.

e.

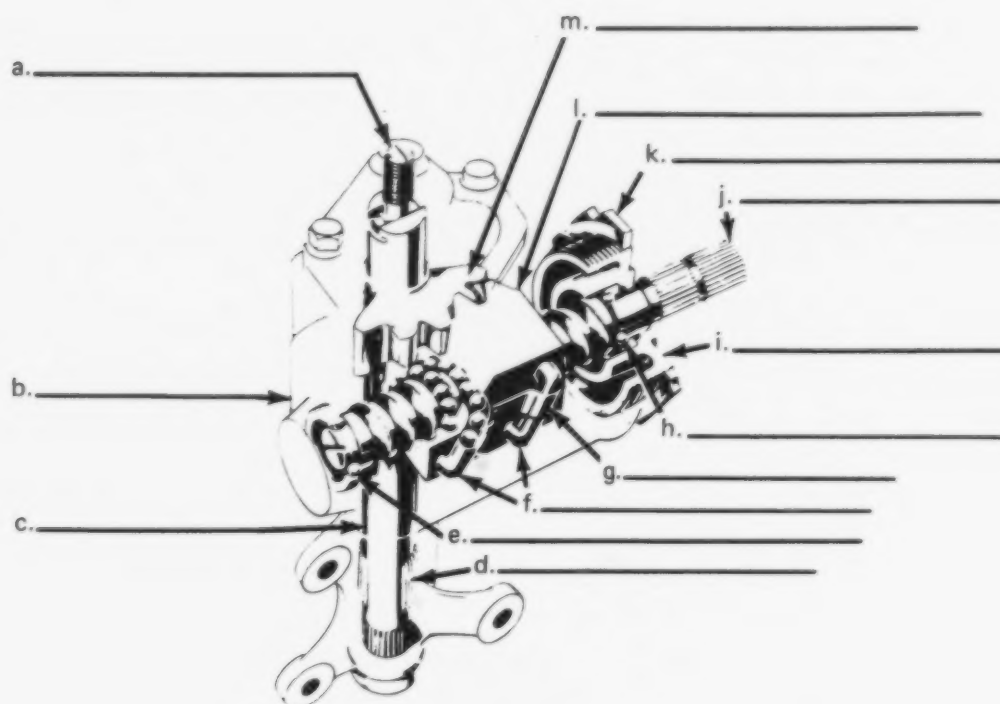
5. List three types of manual steering gears

a.

b.

c.

6. Identify the parts of the recirculating ball nut and worm manual steering gear in the drawing below.



7. List two types of power steering pumps.
 - a.
 - b.
8. Name and describe the three types of power steering systems.
 - a.
 - b.
 - c.
9. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, continue to LAP Step 6. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 6.

**State Department
of
Vocational and Technical
Education
CIMC
Stillwater, Oklahoma
LEARNING ACTIVITY
PACKETS**

for AUTO MECHANICS I

MAJOR INSTRUCTIONAL AREA

SUSPENSION SYSTEM

INSTRUCTIONAL UNIT

WHEEL ALIGNMENT
SECTION D--UNIT VI

LEARNING ACTIVITY PACKET NO.

21

PREREQUISITE LAP(S)

1, 2, 18, 19, 20

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Wheel Alignment." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to explain the purpose of wheel alignment, define wheel alignment angles, and perform alignment and the preliminary checks required prior to alignment.

TASKS INCLUDED IN THIS LAP:

1. Make preliminary checks before wheel alignment.
2. Align a front end.

AUTO MECHANICS I
WHEEL ALIGNMENT
SECTION D--UNIT VI

LEARNING STEPS

Check the Following
Blanks as You Complete
Each Required Step.

- ____ 1. Read Unit and Specific Objectives, page 237-D.
- ____ 2. Complete Wheel Alignment Pre-Test, LAP page 5.
- ____ 3. Study The Sections of the Information Sheet, pages 241-D and 242-D, indicated by your instructor on your Pre-Test. Be sure to refer to the transparency masters when required.
- ____ 4. Do LAP Assignment Sheet #1, LAP page 9.
- ____ 5. Do LAP Assignment Sheet #2, LAP page 11.
- ____ 6. Check The tasks below which you feel that you can do without supervision.

Student
Check

Instructor's
Initials/Date

Skilled

Moderately
Skilled

- ____ a. Make preliminary checks before wheel alignment. (9)
- ____ b. Align a front end (15).

- ____ 7. Discuss Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If both tasks have been initialed, proceed to Step 21. Otherwise, continue to Step 8.

- ____ 8. Refer To Step 6a. If this task has been initialed, proceed to Step 14. Otherwise, continue to Step 9.
- ____ 9. Study Job Sheet #1--Make Preliminary Checks Before Wheel Alignment, page 253-D.
- ____ 10. Watch Slide/tape presentation "Make Preliminary Checks Before Wheel Alignment" (D-VI-1).
- ____ 11. Do Job Sheet #1--Make Preliminary Checks Before Wheel Alignment.
- ____ 12. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and proceed to Step 14. Otherwise, repeat Steps 9-11 and then go to Step 13.
- ____ 13. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and continue to Step 14. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6a and continue to Step 14.
- ____ 14. Refer To Step 6b. If this task has been initialed, proceed to Step 20. Otherwise, continue to Step 15.
- ____ 15. Study Job Sheet #2--Align a Front End, page 259-D.
- ____ 16. Watch Slide/tape presentation "Align a Front End" (D-VI-2).
- ____ 17. Do Job Sheet #2--"Align a Front End."
- ____ 18. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and proceed to Step 20. Otherwise, repeat Steps 15-17 and then go to Step 19.

- ____ 19. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and continue to Step 20. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6b and continue to Step 20.
- ____ 20. Refer To Step 6. If both tasks have been initialed, continue to Step 21. Otherwise, go to the step indicated in parentheses after the unsigned task.
- ____ 21. Review Information Sheet, page 241-D.
- ____ 22. Take Wheel Alignment Unit VI Test (see your instructor). If you achieve a score of 85 percent or more, continue to the next assigned Learning Activity Packet. Otherwise, discuss additional study requirements and possible re-testing with your instructor.

WHEEL ALIGNMENT
UNIT VI

PRE-TEST

NAME _____

SCORE _____

DIRECTIONS: This test is to determine how much you already know about wheel alignment. Your performance on this test will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. Answer only those questions for which you are certain of the answer. Guessing may prevent you from receiving the lessons which are required.

1. Write the purpose of wheel alignment.

2. Match the wheel alignment angles on the right to the correct definitions.

_____ a. Inward tilt of the kingpin or ball joint at the top as compared to true vertical _____ b. Inward or outward tilt of the wheel at the top _____ c. Backward or forward tilt of the wheel at the top _____ d. Backward or forward tilt of the kingpin or ball joint at the top _____ e. Angle made by the inner wheel as compared to the outer wheel when the vehicle goes into a turn _____ f. Angle made between the two wheels when straight and properly aligned _____ g. Amount that wheels are closer together at the extreme front of the tires than at the extreme rear of the tires	1. Camber 2. Caster 3. Toe-in 4. Toe-out on turns 5. Steering axis inclination
--	---

3. Match the wheel alignment angles on the right to the correct purposes.

- | | | |
|----------|---|------------------------------|
| _____ a. | To allow the inner front wheel to roll freely on turns and prevent the outer wheel from dragging | 1. Camber |
| _____ b. | To prevent wear on the inside of the tires | 2. Caster |
| _____ c. | To aid steering stability and establish a pivot point about which the wheel can be easily turned | 3. Toe-in |
| _____ d. | To enable the front wheels to maintain a straight-ahead position or return to a straight-ahead position after a turn has been completed | 4. Toe-out on turns |
| _____ e. | To compensate for varying tolerances in the steering linkage and to prevent excessive tire wear | 5. Steering axis inclination |
| _____ f. | To bring the road contact point of the tire more nearly under the point of load and eliminate excessive tire wear | |
| _____ g. | To ensure that the rear wheels follow directly behind the front wheels | |

4. List seven preliminary steps to wheel alignment.

- a.
- b.
- c.
- d.
- e.
- f.
- g.

5. Stop. Have your instructor evaluate your Pre-Test and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

 I
 II

 III
 IV

You came here from LAP Step 2. If any of the above areas is checked, continue to LAP Step 3. Otherwise, proceed to LAP Step 6.

WHEEL ALIGNMENT
UNIT VI

LAP ASSIGNMENT SHEET #1--WHEEL ALIGNMENT

NAME _____ SCORE _____

1. Write the purpose for wheel alignment by completing the following statement.

To place the wheels of a vehicle in correct relative position to enable a _____ movement over the road without _____, _____, or _____.

2. Match the wheel alignment angles on the right to the correct definitions.

- | | | |
|----------|--|------------------------------|
| _____ a. | Inward tilt of the kingpin or ball joint at the top as compared to the true vertical | 1. Camber |
| _____ b. | Inward or outward tilt of the wheel at the top | 2. Caster |
| _____ c. | Backward or forward tilt of the kingpin or ball joint at the top | 3. Toe-in |
| _____ d. | Angle made by the inner wheel as compared to the outer wheel when the vehicle goes into a turn | 4. Toe-out on turns |
| _____ e. | Amount that wheels are closer together at the extreme front of the tires than at the extreme rear of the tires | 5. Steering axis inclination |

3. Match the wheel alignment angles on the right to the correct purposes. Purposes continue on next page.

- | | | |
|----------|---|------------------------------|
| _____ a. | To allow the inner front wheel to roll freely on turns and prevent the outer wheel from dragging | 1. Camber |
| _____ b. | To aid steering stability and establish a pivot point about which the wheel can be easily turned | 2. Caster |
| _____ c. | To enable the front wheels to maintain a straight-ahead position or return to a straight-ahead position after a turn has been completed | 3. Toe-in |
| _____ d. | To compensate for varying tolerances in the steering linkage and to prevent excessive tire wear | 4. Toe-out on turns |
| | | 5. Steering axis inclination |

- _____ e. To bring the road contact point of the tire more nearly under the point of load and eliminate excessive tire wear

4. List preliminary steps to wheel alignment by placing an "X" beside each correct item to be checked.

- _____ a. Tire conditions
 _____ b. Steering wheel position
 _____ c. Tire pressure
 _____ d. Wheel runout
 _____ e. Camber
 _____ f. Wheel bearing adjustment
 _____ g. Front-end looseness
 _____ h. Shock absorbers
 _____ i. Steering fluid level
 _____ j. Spring way
 _____ k. Wheel balance

5. Stop. Have your instructor evaluate your Assignment Sheet and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

- | | |
|----------|-----------|
| _____ I | _____ III |
| _____ II | _____ IV |

If any of the above areas is checked, study the required areas and then go to LAP Step 5. Otherwise, proceed to LAP Step 6.

WHEEL ALIGNMENT
UNIT VI

LAP ASSIGNMENT SHEET #2--WHEEL ALIGNMENT

NAME _____ SCORE _____

1. Write the purpose of wheel alignment.

2. Define the following wheel alignment angles.

a. Camber -- _____

b. Caster -- _____

c. Steering axis inclination -- _____

d. Toe-in -- _____

e. Toe-out on turns -- _____

3. Describe the purpose of each of the following wheel alignment angles.

a. Camber -- _____

- b. Caster -- _____

- c. Steering axis inclination -- _____

- d. Toe-in -- _____

- e. Toe-out on turns -- _____

4. List the preliminary steps to wheel alignment.

- a.
 - b.
 - c.
 - d.
 - e.
 - f.
 - g.
5. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, continue to LAP Step 6. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 6.